PHILOSOPHICAL TRANSACTIONS.

GIVING SOME

ACCOUNT

OF THE

Present Undertakings, Studies, and *Labours*

OF THE

INGENIOUS,

IN MANY

Considerable Parts of the WORLD.

VOL. XXXVI. For the Years 1729, 1730.

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TO

Sir *HANS SLOANE*, Bart.

PRESIDENT,

AND TO THE

COUNCIL and FELLOWS

OF THE

ROYAL SOCIETY

Of *LONDON*, for

Improving Natural Knowledge,

This Thirty-ſixth VOLUME of

Philoſophical Tranſactions

is humbly Dedicated

BY

Their moſt Devoted,

And moſt Obliged Servant,

CROMWELL MORTIMER, *R. S. Secr.*

Numb. 407.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *January* and *February* 1729.

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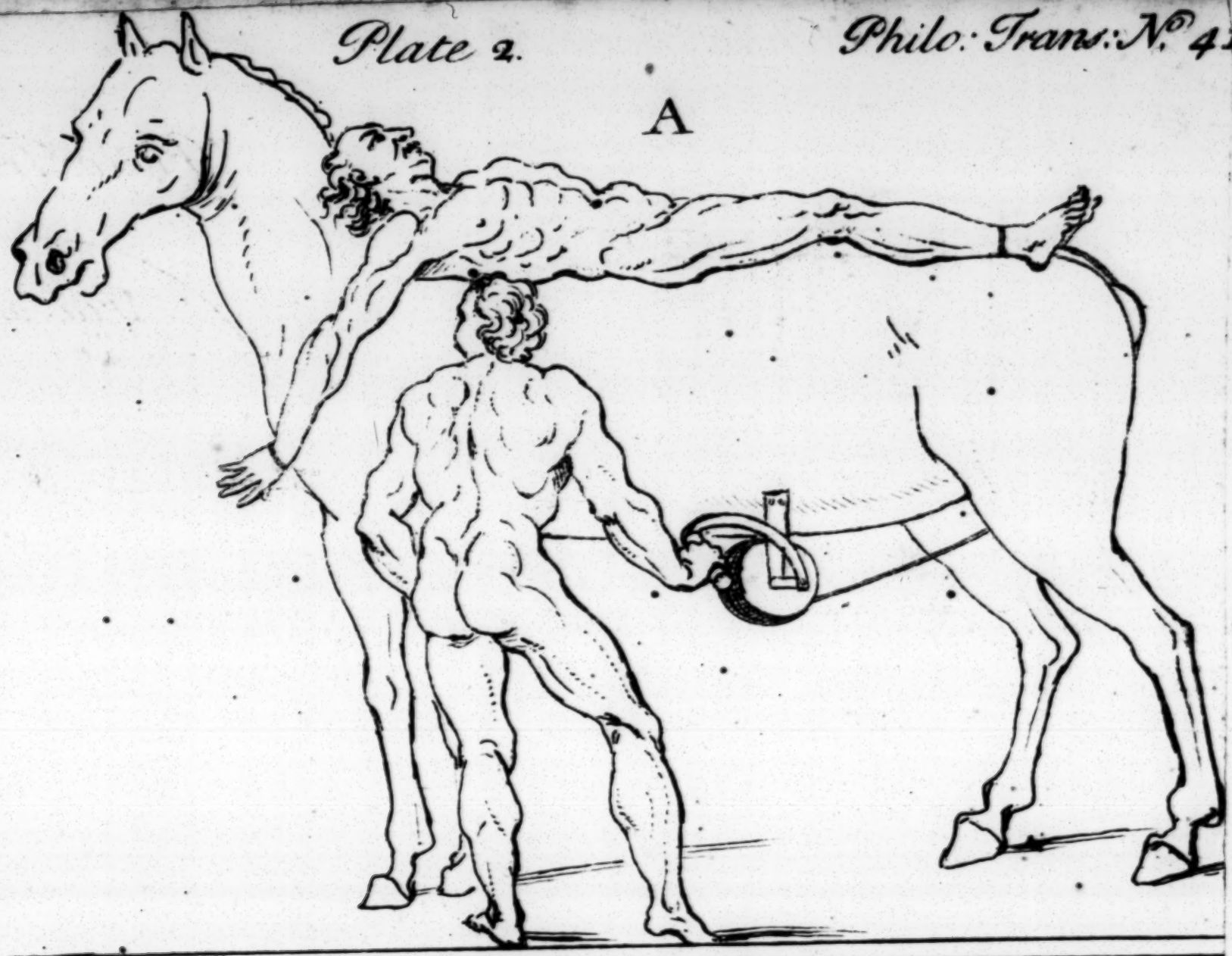
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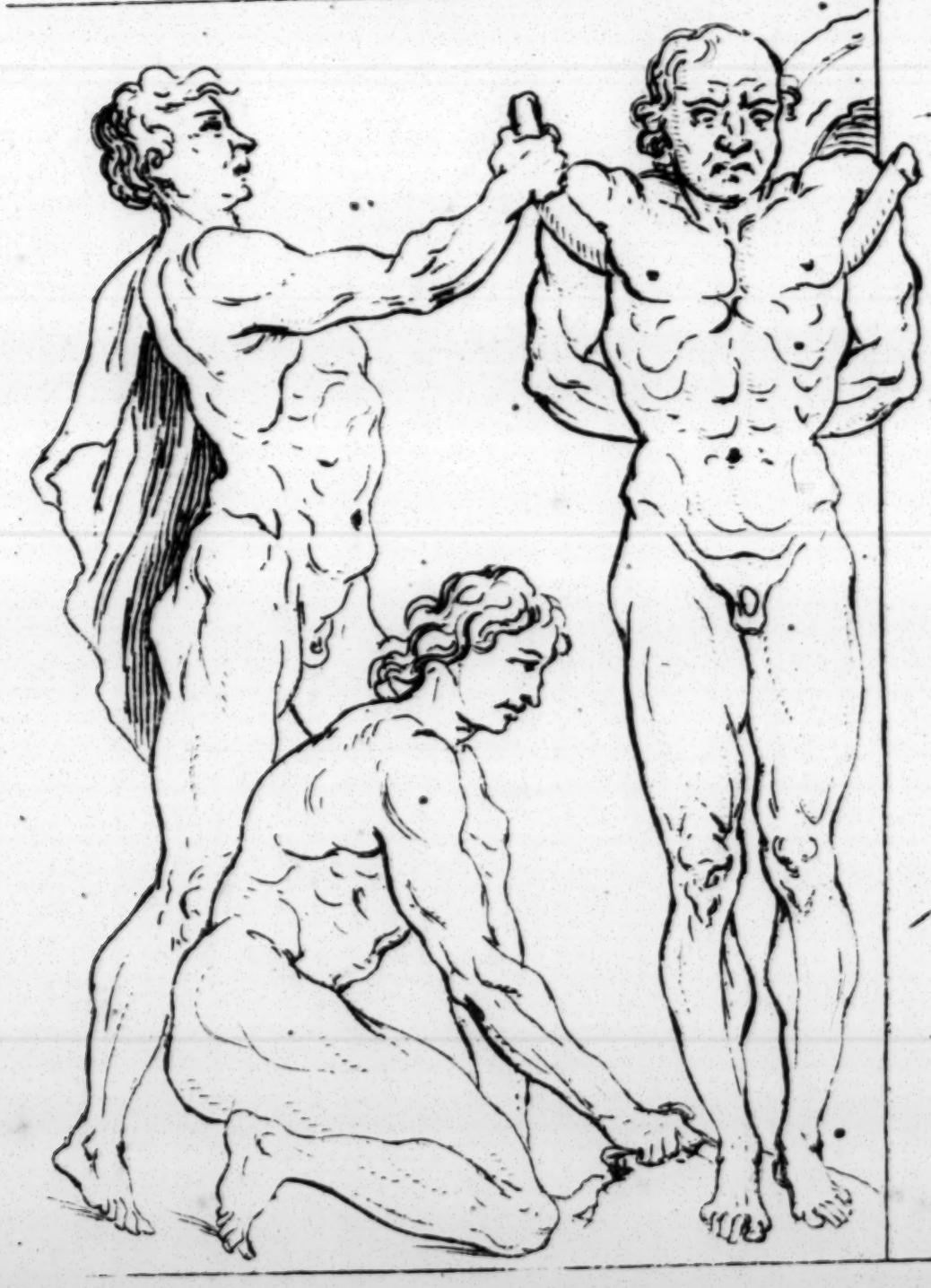
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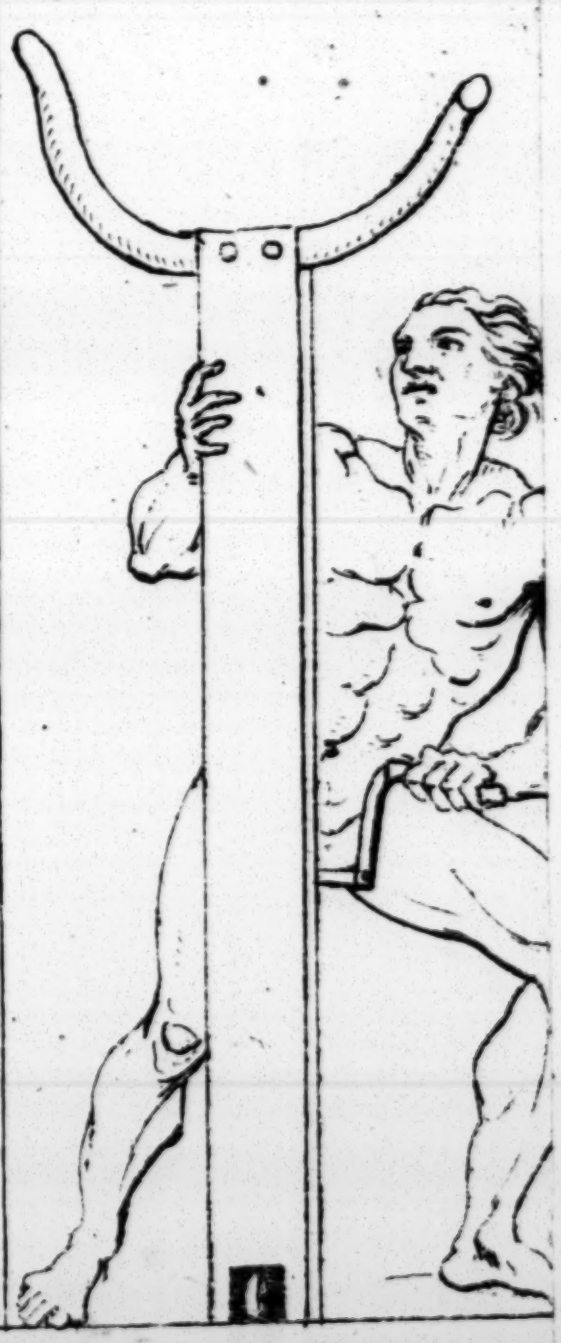
I. *A*

A



B





I. *A Catalogue of the fifty Plants from* Chelſea-Garden, *preſented to the Royal Society, by the Company of* Apothecaries, *for the Year* 1727, *purſuant to the Direction of Sir* Hans Sloane, *Bart. Med. Reg. Præſ. Col. R. Med. & Soc. Reg. by* Iſaac Rand *Apothecary, F. R. S.*

251 ACetoſa Ocimi folio, Neapolitana, C. B. 114.
252 Acetoſa veſicaria peregrina Hort. Eyſt.
253 Alcea afra, fruteſcens, folio Groſſulariæ; flore parvo rubro Boerh. Ind. alt. 271.
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256 Althæa fruteſcens, folio acuto; parvo flore, C. B. 316.
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258 Althæa arborea, folio amplo, ſerrato.
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270 Eupatorium Valerianoides, Triſſaginis folio, abſq; pediculis, Virginianum. Pluk. Phyt. Tab. 88. f. 4.

271 Glycyrrhiza capite echinato. C. B. 352.

272 Gramen dactylon, majus; panicula longa; ſpicis plurimis nudis craſſis. Sloane, Hiſt. v. i. 112 Tab. 69. f. 2.

273 Gramen dactylon, paniculâ longâ; è ſpicis plurimis gracilioribus, purpureis mollibus conſtante. Sloane, Hiſt. v. i. 113. Tab. 70. f. 2.

274 Heliotropium Americanum, cæruleum; foliis Hormini. Dodart. Mem. 83.

275 Heliotropium majus Dioſcoridi. C. B. 253.

276 Jacea cum ſquamis pennatis, ſive capite villoſo. I. B. 3. 28.

277 Ketmia Syrorum quibuſdam. C. B. 316.

278 Linaria capillaceo folio. C. B. 213.

279 Linaria cærulea, foliis brevioribus & anguſtioribus. Raii. Syn. Ed. 3. 282.

280 Perſicaria mitis. J. B. 3. 779.

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282 Perſicaria orientalis, Nicotianæ folio; calyce florum purpureo. T. Cor. 38.

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284 Portulaca Coraſſavica procumbens; Capparidis folio; flore muſcoſo; capſula bifurcata. Parad. Bat. 213.

285 Ranunculus hirſutus, annuus; flore minimo. Raii Syn. Ed. 2. 135.

286 Ricinus minor Staphys agriæ folio ; flore pentapetalo purpureo Sloane Hiſt. Vol. I. 129. Tab. 84.
287 Sonchus lævis in plurimas & tenuiſſimas lacinias diviſus. C. B. 124.
288 Spinacia Cretica, ſupina ; capſulâ ſeminis aculeata. T. Inſt. 533.
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290 Santolina foliis teretibus. T. Inſt. 460.
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294 Santolina vermiculata Cretica. ib.
295 Santolina incana ; Chamæmeli odore ſuaviore. Boerh. Ind. alt. 123.
296 Santolina tota viridis ; foliis Ericæ aut Sabinæ. *an* 3 *Dodon.* 269 ?
297 Santolina caneſcens foliis Cupreſſi. *an* 4 *Dodon. ib?*
298 Santolina minor candidiſſima.
299 Tithymalus erectus acris ; Parietariæ foliis glabris ; floribus ad caulium nodos conglomeratis. Sloane Hiſt. v. i. 197. Tab. 126.
300 Tormentilla reptans, alata, foliis profundius ferratis D. Plot. Raii Syn. Ed. 2. 142.

ERRATA.

IN Philoſ. Tranſact. N°. 399, ſome Miſtakes of the Preſs in the Catalogue of the fifty Plants ought to be thus corrected. Pag. 293, after 203 and 208, dele this Mark — Pag. 294, after the following Numbers, 213, 214, 217, 218, 219, 220, 222, 225, dele — Pag. 295, after the following Numbers, 236, 237, 244, 246, 248, dele —

II. *An Account of the firſt Decade of a Book, Intituled,* Johannis Martyn Hiſtoria Plantarum rariorum. *Printed at* London ; *by* Richard Reily, 1728. *by Mr.* Rand, *F. R. S.*

MR. *Martyn* in this Work has had the Plants, of their natural Bigneſs, exactly deſigned after the Life, and with great Accuracy and Succeſs printed in their proper Colours. This curious Invention was never more aptly applied, though I think this is the firſt time it has been uſed in *Botany*. By this Means, without a long tedious Deſcription, a Plant may be known by meer Inſpection. However, that nothing may be wanting, the Author has thought fit to give ſhort Deſcriptions, inſiſting more particularly on thoſe minute Parts which cannot be ſo clearly expreſſed by Sculpture; and has added, where they could be obtain'd, ſome Account of their Uſes, *&c.*

The Plant in the firſt Table he calls *Jalapa Officinarum.*

The *Jalap* Root has been in common Uſe above a hundred Years; yet the Plant it ſelf wholly unknown to us in *Europe* till P. *Plumier* and M. *Lignon*, who had both paſſed a conſiderable Time in *America* in Botanical Diſquiſitions, at their Return, ſeverally aſſured Mr. *Tournefort*, that it was a Species of the Plant commonly known by the Name of *Marvel* of *Peru*; who thereupon thought fit to make *Jalapa* the Name of the Genus, and diſtinguiſh that of the Shops by the Seeds being more rugoſe than thoſe of the common.

Tab. 2.

Tab. 2. Shews the *Geranium Africanum, Arboreſcens, Malvæ folio, lucido; flore elegantiſſimo Kermeſino Domini van Leur. Boerh. Ind. alt.* 262.

3. *Geranium Chium, vernum; Caryophyllatæ folio T. Cor.* 20.

4. *Brunella Caroliniana, magno flore, dilutè cæruleo, internodiis prælongis, Phil. Tranſ.* No. 395. Pag. 125.

5. *Amaranthus Sinenſis foliis variis; paniculâ eleganter plumoſo.*

6. *Amaranthus ſpicâ albeſcente habitiore.*

7. *Parietaria Orientalis, Polygoni folio caneſcente T. Cor.* 38.

8. *Niruri Barbadenſe, folio Ovali ſubtus glauco, pediculis florum breviſsimis, Phil. Tranſ.* No. 399. Pag. 295.

This is of the ſame Genus with that called *Niruri, Hort. Malab.* Tom. x. and there deſcribed, p. 53. Ours is a much ſmaller Plant, the Leaves are leſs, and grow much cloſer on the Stalks, and the Pedicle of each Flower by two thirds ſhorter.

9. *Lychnidea Caroliniana floribus Umbellatim diſpoſitis, foliis lucidis craſsis.* This Plant is ſomething like *Lychnidea Virginiana Holoſtei ampliore folio, floribus umbellatis purpureis Phil. Tranſ.* No. 395. Pag. 126. but the Leaves are much larger, thicker, and of a deep ſhining green Colour.

10. *Aloe Africana, foliis planis, conjugatis, carinatis verrucoſis, caule & flore Corallii colore Boerh. Ind. alt.* p. 2. Pag. 131.

The ingenious Author propoſes, in the Sequel of this Work, to give an Account of new Plants only, or at leaſt ſuch as have not been well figured by others: If he proceeds with the ſame Exactneſs, as I don't doubt he will, the Work very well deſerves Encouragement; for of Plants thus figured and deſcribed, there can be no future Doubts.

Happy had it been for us, had the Antients left ſuch Types or Deſcriptions of thoſe they recommended as conſiderable for their Uſe in Medicine. This would have ſaved the Learned World much Labour and Study in an Enquiry, which 'tis to be feared, for want of ſuch Helps, will prove unſucceſsful.

III. *An Attempt to ſolve the Phænomenon of the Riſe of Vapours, Formation of Clouds and Deſcent of Rain. In a Letter from Dr.* J. T. Deſaguliers, *L L. D. F. R. S. to Dr.* Rutty, *R. S. Secr.*

SIR,

THE Reaſon of my writing upon a Subject which has been ſo often treated of, is, that none of the Accounts hitherto given of this *Phænomenon* (at leaſt that I have met with) ſeem to me ſufficient to ſolve all the Circumſtances of it.

Dr. *Niewentyt* and ſome others ſay — That Particles of Fire ſeparated from the Sun-Beams, by adhering to Particles of Water, make up *Moleculæ*, or ſmall Bodies ſpecifically lighter than Air, which therefore, by hydroſtatical Laws, muſt riſe and form Clouds that remain ſuſpended when they are riſen up to ſuch an Height

Height that the Air about them is of the ſame ſpecifick Gravity with themſelves. ——

That Rain is produced by the Separation of the Particles of Fire from thoſe of Water, which laſt being then reſtored to their former ſpecifick Gravity, can no longer be ſuſtained by the Air, but muſt fall in Drops. See *Niewentyt's Religious Philoſopher.* Contemplation 19. From Sect. xiii. to Sect. xxv.

Now this is liable to ſeveral Objections, *Firſt*, It is built upon a Suppoſition that Fire is a particular Subſtance, or diſtinct Element, which has never yet been prov'd by convincing Experiments and ſufficient Obſervations; and which the Reverend Mr. *Hales* has in his late excellent Book of *Vegetable Staticks* ſhewn to be an ill grounded Opinion, making it very plain, that in Chymical Operations thoſe Bodies which had been thought to become heavier by Particles of Fire adhering to them, were only ſo by Adheſion of Particles of Air, *&c.* which he has ſhewn to be *abſorbed* in great Quantities, by ſome Bodies, whilſt it is *generated* (or reduced from a fixt to an elaſtick State) by others; nay, that it may be *abſorbed* and *generated* ſucceſſively by the ſame Body, under different Circumſtances.

Secondly, If we ſhould allow the above-mentioned Suppoſition, the Difficulty will ſtill remain about the Production of Rain by the Separation of the Fire from the Water; For Dr. *Niewentyt* aſcribes this Effect to two different Cauſes. *Firſt*, to Condenſation (*Sect.* xxiii.) Saying, "That when contrary Winds blow "againſt the ſame Cloud and drive the watery Par-"ticles together, the Fire that adhered to them gets "looſe, and they (becoming then ſpecifically heavier) "precipitate and fall down in Rain". Then in the very

very next *Sect.* he aſcribes it to Rarefaction, when he ſays, " That when a Wind blowing obliquely upwards " cauſes a Cloud to riſe into a thinner Air (*i. e.* ſpe- " cifically lighter than it ſelf) the Fire which by " ſticking to the Particles of Water rendered them light- " er, extricates it ſelf from them, and aſcending by its " Lightneſs, the Water will become too heavy, not " only to remain in this thin and light Air, but " even in a thicker and heavier near the Earth, and " ſo will be turned into a deſcending Dew, Miſt, or Rain, " or Snow, or the like, according as the watery Va- " pours are either rarefied or compreſſed".

The firſt of theſe Cauſes of Rain is contrary to Expe- rience; for when two contrary Winds blow againſt each other over any Place of the Earth, the Barometer always riſes, and we have fair Weather. For then (as Dr. *Halley* ſays, in Philoſophical Tranſ. No. 183) the Air being accumulated above, becomes ſpecifically heavier about the Clouds, which (inſtead of falling in- to Rain, as Dr. *Niewentyt* ſuppoſes) aſcend up into ſuch a Part of the Atmoſphere, as has the Air of the ſame ſpecifick Gravity with themſelves.

If the falling of Rain might be attributed to the ſe- cond of theſe Cauſes, then every time a Cloud is encom- paſſed with Air ſpecifically lighter than it ſelf (whe- ther it be when by the blowing away ſome of the ſupe- rior Air, that which is about the Cloud becomes ra- rer as it is leſs compreſſed, or by the Cloud being dri- ven upwards) Rain muſt neceſſarily follow; whereas one may often ſee the Clouds riſe and fall without Rain, even when the Barometer ſhews the Weight of the Air to be alter'd. For that happens only when by the great Diminution of the ſpecifick Gravity of the Air about

the

the Cloud, it has a great Way to fall; in which Caſe, the Reſiſtance of the Air, which increaſes as the Square of the Velocity of the deſcending Cloud, cauſes the floating Particles of Water to come within the Power of each others Attraction, and form ſuch big Drops, as being ſpecifically heavier than any Air, muſt fall in Rain.

No gentle Deſcent of a Cloud, but only an accelerated Motion downwards, produces Rain.

N. B. *I don't mean that the quick Deſcent of a Cloud is the only Cauſe of Rain; becauſe the Shock from a Flaſh of Lightning, and the ſudden return of the Air, after the* Vacuum *made by the Flaſh, will condenſe the floating Vapour into Water; and alſo the ſame Cloud which in the free Air, might be carried horizontally without being turned into Rain, meeting with an high Hill in its Way, will be condenſed and fall in Drops; eſpecially if, in the Day-time, it be driven by the Wind out of the Sun-ſhine, againſt the ſhaded Side of the Mountain.*

Beſides all this, if Particles of Fire were joined with thoſe of Water to raiſe them up, thoſe igneous Particles muſt be at leaſt 1000 Times greater in Bulk than the watry ones; ſo that a Perſon, who at the Top of a Hill, has his Hands and Face in a Cloud, muſt feel a very ſenſible Warmth, by touching a much greater Surface of Fire than Water in the Cloud, and afterwards find the Rain produced from that Vapour ſenſibly colder; whereas the contrary is proved by our Senſes; the Tops of Hills, though in the Clouds, being much colder than the Rain at Bottom.

There is another Opinion concerning the Riſe of Vapours, namely, that tho' Water be ſpecifically heavier than Air, yet if its Surface be encreaſed by very much diminiſhing the Bulk of its Particles, when once raiſed, it cannot eaſily fall; becauſe the Weight of each Particle diminiſhes as the Cube Root of its Diameter, and the Surface to which the Air reſiſts, only as the Square Root of the ſaid Diameter: That we ſee this in the Duſt in Summer, and in Menſtruums that ſuſtain Metals diſſolved, which are ſpecifically heavier than the Menſtruums.

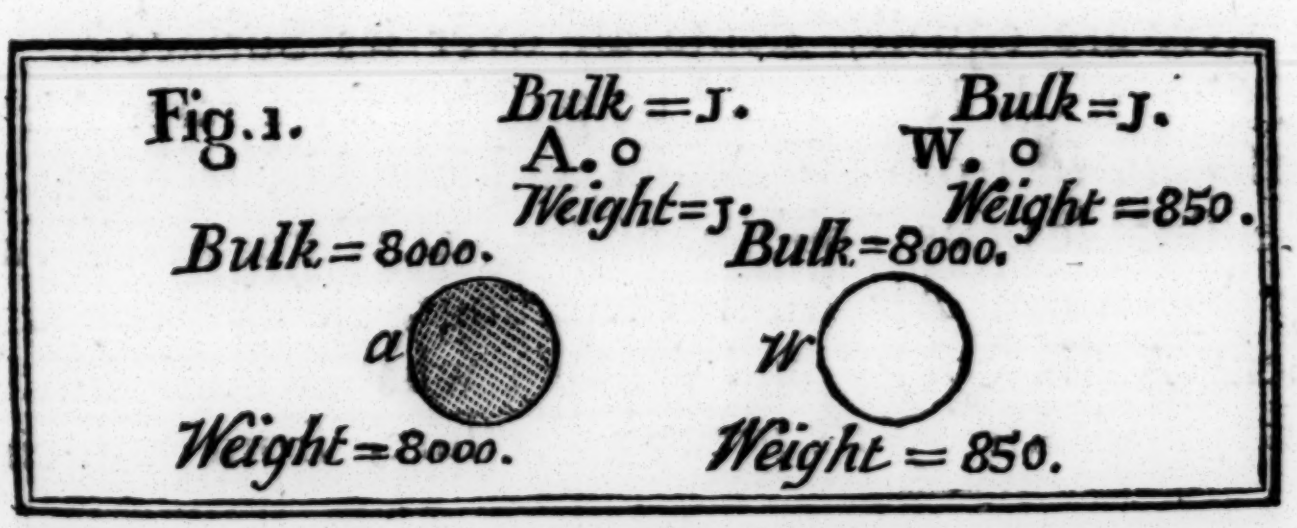
But this will not explain the *Phænomenon*; becauſe though the Encreaſe of Surface (the Weight remaining the ſame) will in a great Meaſure hinder (or rather retard) the Deſcent of ſmall Bodies moving in the Air, by reaſon of its great Reſiſtance to ſo large a Surface; it will for the ſame Reaſon alſo hinder the Aſcent. For the Riſe of Duſt is owing to the Motion of Animals Feet in it, or to the Wind: Whereas Vapours riſe in calm Weather, as well as windy; neither do they, like the Duſt, always fall to the Ground when the Wind ceaſes to blow.

The third Opinion, and which is moſt commonly received, is, that by the Action of the Sun on the Water, ſmall Particles of Water are formed into hollow Spherules filled with an *Aura*, or finer Air highly rarefied, ſo as to become ſpecifically lighter than common Air, and conſequently that they muſt riſe in it by hydroſtatical Laws. As for Example, If a Particle of Water, as it becomes a hollow Sphere, be only encreaſed ten Times in Diameter, its Bulk will be encreaſed a thouſand Times; there-

fore it will then be ſpecifically lighter than common Water, whoſe ſpecifick Gravity is to that of Air, as 850 to 1; then if the Denſity of the *Aura*, or Spirit within the little Shell, be ſuppoſed 9 Times leſs than that of Air, or as 50 to 850, that ſpecifick Gravity of the Shell, and its Contents will be to that of Air, as 900 to 1000; therefore ſuch an aqueous Bubble muſt riſe till it comes to an Æquilibrium in Air, whoſe Denſity is to the Denſity of that in which it began to riſe, as 850 to 945 nearly. But it appears by Experiments, that Air rarefied by an Heat which makes a Retort red hot, is only encreaſed in Bulk, or dilated 3 Times; by the Heat of boiling Water only $\frac{10}{14}$ or near two Thirds; and by the Heat of the Humane Body (ſuch as will raiſe Vapours plentifully) only $\frac{10}{39}$ or about $\frac{1}{4}$. I own my Objection may be anſwered, by ſuppoſing the Spherule of Water to be more encreaſed in Diameter, as for Example 20 Times; becauſe then if it be filled with Air only $\frac{1}{4}$ rarer than common Air, it will be ſpecifically lighter, and capable of riſing to a conſiderable Height.

To give this Solution all its Force, let us expreſs it in Numbers. Let A and W (*Fig.* 1.) repreſent

Fig. 1.



a Particle of Air, and one of Water of equal Bulk, then will the Weight of A be to the Weight of W as 1 to 850, their Bulks being equal. If the Particle of Water be blown up into a Bubble (*w*) of 20 Times its Diameter, then will its Bulk be to its Weight, as 8000 to 850, whilſt a Sphere of Air (*a*) of the ſame Bigneſs, has its Weight as well as Bulk equal to 8000: Now if an Air or *Aura* $\frac{1}{4}$ rarer than common Air be ſuppoſed within the watry Bubble to keep it blown, it will be the ſame as if $\frac{3}{4}$ of the Air of (*a*) was carried into (*w*) and then the Weight of (*w*) would be encreaſed by the Number 6000; ſo that the Shell of Water being in Bulk 8000, would be in Weight $850 + 6000 = 6850$, whilſt an equal Bulk of Air weighed 8000, and conſequently the watry Bubble would riſe till it came to an Air, whoſe Denſity is to the Denſity of the Air next to the Surface of the exhaling Water as 6850 to 8000.

This is the ſtrongeſt Way of ſtating the Hypotheſis. But to ſupport it, the following Queries muſt be anſwered.

Query 1ſt, How comes the *Aura*, or Air in the Bubbles, to be ſpecifically lighter than the Air without them, ſince the Sun's Rays, which act upon the Water, are equally denſe all over its Surface?

Query 2d, If it could be poſſible for a rarer Air to be ſeparated from the denſer ambient Air, to blow up the Bubbles (as Bubbles of ſoaped Water are blown up by warm Air from the Lungs, whilſt the ambient Air is colder and denſer) what would hinder that cold Air by its greater Preſſure, from reducing the

the Bubbles to a leſs Bulk, and greater ſpecifick Gravity than the Air, eſpecially ſince Cold can be communicated through ſuch thin Shells, and the Tenacity of common Water is very ſmall when compared to that of ſoaped Water (whoſe Bubbles, notwithſtanding that Tenacity) are ſoon deſtroyed by the Preſſure of the outward Air, as the Air within them cools?

Query 3d, If we ſhould grant all the reſt of the Suppoſition, yet this Difficulty will remain. If Clouds are made up of hollow Shells of Water filled with Air, why do not thoſe Clouds always expand when the ambient Air is rarefied, and preſſes leſs than it did before, and alſo ſuffer a Condenſation, as the ambient Air is condenſed by the Accumulation of the ſuperiour Air?

If this Condenſation and Rarefaction ſhould happen to the Clouds, they would always continue at the ſame Height, contrary to Obſervation; and we ſhou'd never have any Rain.

From all this it follows, that the Condenſation and Rarefaction of the Vapours, which make Clouds, muſt depend upon another Principle than the Condenſation and Rarefaction of the Air: And that there is ſuch a Principle, I ſhall endeavour to ſhew.

LEMMA

LEMMA.

The Particles of all Fluids have a repellent Force.

FLUIDS are elaſtick or unelaſtick: The elaſtick Fluids have their Denſity proportionable to their Compreſſion, and Sir *Iſaac Newton* has demonſtrated (*Princip. Lib.* ii. *Sect.* v.) that they conſiſt of Parts that repel each other from their reſpective Centers. Unelaſtick Fluids, like Mercury, Water and other Liquors, are by Experiments found to be incompreſſible; for Water in the *Florentine Experiment* could not by any Force be compreſſed into leſs Room, but ooz'd like Dew through the Pores of the hollow golden Ball in which it was confined, when a Force was apply'd to preſs the Ball out of its ſpherical, into a leſs capacious Figure. Now this Property of Water and other Liquors muſt be intirely owing to the centrifugal Force of its Parts, and not its want of Vacuity; ſince Salts may be imbib'd by Water without encreaſing its Bulk, as appears by the Encreaſe of its ſpecifick Gravity. So Metals, which (ſingly) have a certain ſpecifick Gravity beyond which they cannot be condens'd, will yet receive each other in their Interſtices ſo as to make a Compound ſpecifically heavier than the heavieſt of them; as is experienced in the Mixture of Copper and Tin.

SCHO-

SCHOLIUM.

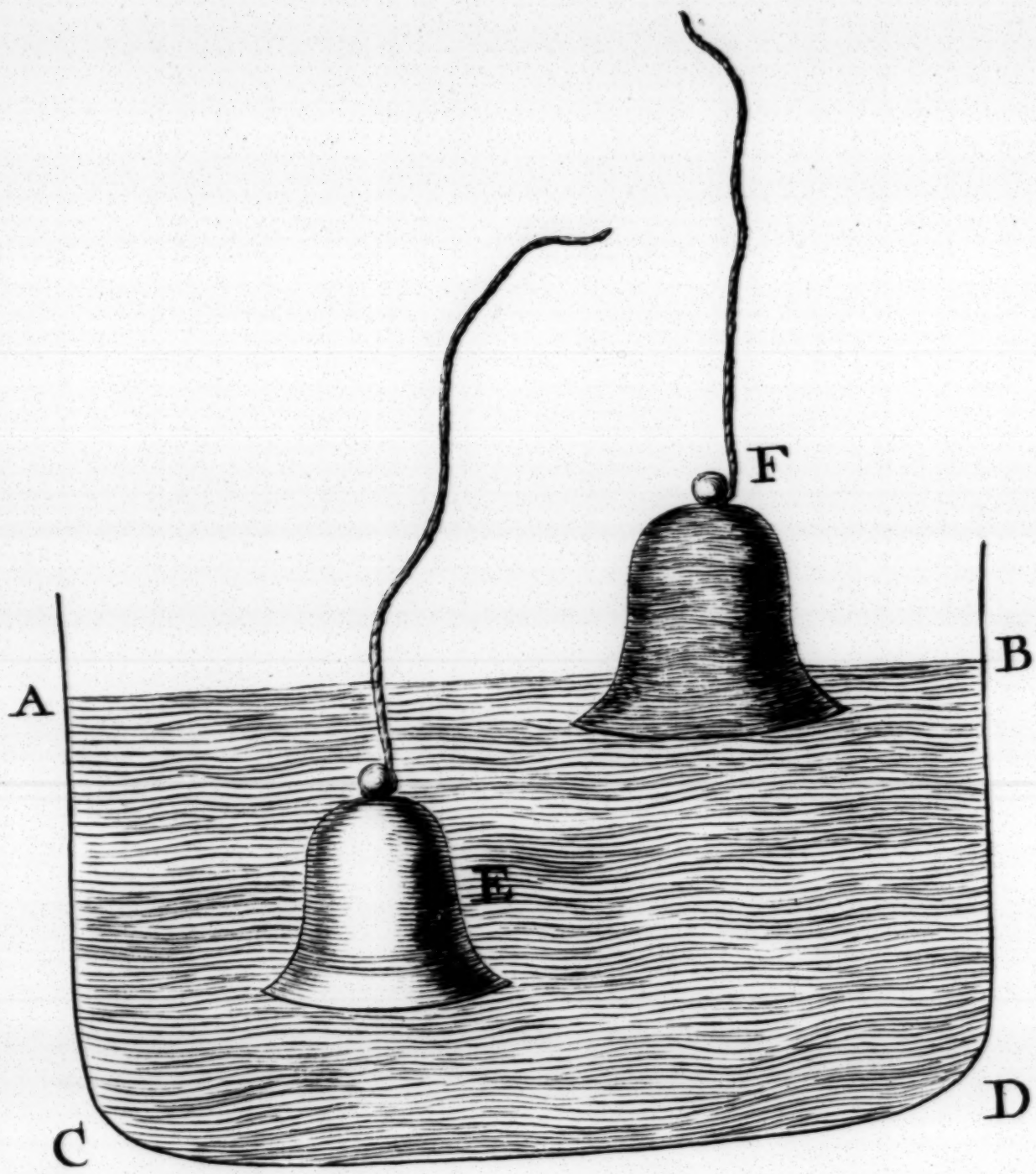
By encreaſing the repellent Force of the Particles, an unelaſtick or incompreſſible Fluid may become elaſtick, or a Solid (at leaſt a great Part of it) may be changed into an elaſtick Fluid; and, *vice versâ*, by diminiſhing the repellent Force, an elaſtick Fluid may be reduc'd to an unelaſtick Fluid, or to a Solid. That the Particles of Quickſilver, Water and other Liquors are likewiſe endued with an attractive Force, is evident from thoſe Subſtances running into Drops in an exhauſted Receiver, as well as in the Air, and likewiſe their adhering to other Bodies. The Attraction and Repulſion exert their Forces differently: The Attraction only acts upon the Particles, which are in Contact, or very near it; in which Caſe it overcomes the Repulſion ſo far, as to render that Fluid unelaſtick, which otherwiſe would be ſo; but it does not wholly deſtroy the Repulſion of the Parts of the Fluid, becauſe it is on Account of that Repulſion that the Fluid is then incompreſſible. When by Heat or Fermentation (or any other Cauſe, if there be any) the Particles are ſeparated from their Contact, the Repulſion grows ſtronger, and the Particles exert that Force at great Diſtances, ſo that the ſame Body ſhall be expanded into a very large Space by becoming fluid, and may ſometimes take up more than a Million of Times more Room than it did in a ſolid or incompreſſible Fluid. (See the *Queries* at the End of Sir *Iſaac Newton*'s Opticks.) Thus is Water

by

by boiling, and leſs Degrees of Heat, changed into an elaſtick Vapour rare enough to riſe in Air, Oils and Quickſilver in Diſtillation made to riſe in a very rare Medium, ſuch as remains in the red-hot Retort, and ſulphureous Steams will riſe even in an exhauſted Receiver, as the Matter of the *Aurora Boreàlis* does in the thinner Part of our Atmoſphere. If Aqua-fortis be poured on Quickſilver, a reddiſh Fume will riſe much lighter than common Air; ſo alſo will Fumes riſe from Filings of Metals, from Vegetables when they ferment by Putrefaction; and (as the Reverend Mr. *Hales* has ſhewn) ſeveral ſolid Subſtances by diſtilling, as well as Fermentation, will *generate* permanent Air.

That Heat will add Elaſticity to Fluids is evident from numberleſs Experiments, eſpecially from Diſtilling and Chymiſtry: But what is needful to conſider here is only, that it acts more powerfully on Water than common Air; for the ſame Heat which rarefies Air only $\frac{2}{3}$ will rarefy Water very near 14000 times, changing it into Steam or Vapour as it boils it: And in Winter, that ſmall Degree of Heat, which in Reſpect to our Bodies appears cold, will raiſe a Steam or Vapour from Water at the ſame Time that it condenſes Air.

By a great many Obſervations made by Mr. *Henry Beighton*, F. R. S. and my ſelf, upon the Engine to raiſe Water by Fire, according to Mr. *Newcomen*'s Improvement of it; we found that the Water in boiling is expanded 14000 times to generate a Steam as ſtrong (*i. e.* as elaſtick) as common Air, which therefore muſt be near $16\frac{1}{2}$ times ſpecifically


F
A
B
E
C
D

cifically lighter. And that this Steam is not made of the Air extricated out of the Water is plain, becauſe it is condens'd again into Water by a Jet of cold Water ſpouting in it; and the little Quantity of Air that comes out of the injected Water muſt be diſcharged at every Stroke, otherwiſe the Engine will not work well. There is alſo another Experiment to confirm this.

EXPERIMENT.

ABCD is a pretty large Veſſel of Water, which muſt be ſet upon the Fire to boil. In this Veſſel muſt be ſuſpended the glaſs Bell E, made heavy enough to ſink in Water; but put in, in ſuch a Manner that it be filled with Water when upright, without any Bubbles of Air at its Crown within, the Crown being all under Water. As the Water boils, the Bell will by Degrees be emptied of its Water, being preſs'd down by the Steam which riſes above the Water in the Bell; but as that Steam has the Appearance of Air, in order to know whether it be Air or not, take the Veſſel off the Fire, and draw up the Bell by a String faſten'd to its Knob at Top, till only the Mouth remains under Water; then, as the Steam condenſes by the cold Air on the outſide of the Bell, the Water will riſe up into the Bell at F quite to the Top, without any Bubble above it, which ſhews that the Steam which kept out the Water was not Air.

N. B. *This Experiment ſucceeds beſt when the Water has been firſt purg'd of Air by boiling, and the Air-Pump.*

We know by ſeveral Experiments made on the Fire-Engine (in Captain *Savery*'s Way, where the

Steam is made to preſs immediately on the Water) that Steam will drive away Air, and that in Proportion to its Heat; though in the open Air it floats and riſes in it like Smoak.

Now if the Particles of Water turn'd into Steam or Vapour repel each other ſtrongly, and repel Air more than they repel each other; Aggregates of ſuch Particles made up of Vapour and Vacuity may riſe in Air of different Denſities, according to their own Denſity dependant on their Degree of Heat, without having Recourſe to imaginary Bubbles form'd in a Manner only ſuppoſed, and not proved, as we have already ſhewn. *I own indeed, that if the watry Particles had no repellent Force, they muſt precipitate in the ſame Manner that Duſt will do after it has been raiſed up; but we have too many Obſervations and Experiments to leave any Doubt of the Exiſtence of the repellent Force above-mentioned. Neither can I ſhew by any Experiment, how big the* Moleculæ *of Vapour muſt be which exclude Air from their Interſtices, and whether thoſe* Moleculæ *do vary in Proportion to the Degree of Heat by an Increaſe of repellent Force in each watry Particle, or by a farther Diviſion of the Particles into other Particles ſtill leſs; but in general we may reaſonably affirm, that the Rarity of the Vapour is proportionable to the Degree of its Heat, as it happens in other Fluids* (*See* Phil. Tranſact. *Numb.* 270.) *and that, though the different Degrees of the Air's Rarefaction are alſo proportionable to the Heat; the ſame Degree of Heat rarefies Vapour much more than Air.*

Now to ſhew, that what has been ſaid will account for the Riſe of Vapours and Formation of Clouds,

Clouds, we muſt only conſider; —— whether that Degree of Heat, which is known to rarefy Water 14000 * Times, being compared with ſeveral of thoſe Degrees of Heat in Summer, Autumn and Winter, which are capable of raiſing Exhalations from Water or Ice; the Rarity of the Vapours (eſtimated by the Degree of Heat) will appear to be ſuch, that the Vapour will riſe high enough in Winter, and not too high in Summer, to agree with the known *Phænomena*.

That the Effects are adequate to the Cauſes in this Caſe, I think I can make out in the following Manner, viz.

The Heat of boiling Water, according to Sir *Iſaac Newton*'s Table (*Phil. Tranſact.* Num. 270) is 34, the mean Heat of Summer 5, the mean Heat of Spring or Autumn 3, and the leaſt Degree of Heat, at which Vapours riſe in Winter (*alias* the mean Heat of Winter) is 2. The Rarity of Vapour proportionable to theſe four Degrees of Heat, is 14000, 2058, 1235, and 823. The Rarity of Air is, in Summer 900, in Spring or Autumn 850, and in Winter 800, the Denſity of Water compared with the above-mentioned Denſities, being inverſely as *One* to the ſaid fore-mentioned four Numbers. The Heights above the Earth to which the Vapours will riſe, and at which they will be in *æquilibrio*, in an Air of the ſame Denſity with themſelves, will vary according to the Rarity of the Vapour depending on the Heat of the Sea-

* *As the Digreſſion wou'd be too long to mention here thoſe Obſervations on the Fire-Engine, which ſhew that the Vapour from boiling Water is expanded* 14000 *Times more than cold Water; I refer the Reader to the* 6*th* Section *of* 25*th* Contemplation *of* Niewentyt's Religious Philoſopher, *where he proves by an Experiment made with an Æolipile, that one Inch of Water produces* 13365 *Inches of Vapour; which, conſidering the great Allowances made againſt the Aſſertion, may well be call'd* 14000.

ſon. For the Vapour which is raiſed by the Winter's Heat, expreſſed by the Number 2, when the Air's Rarity is 800, will riſe to (and ſettle at) an Height of about the Sixth of a Mile, when the Barometer is above 30 Inches high. But if the Heat be greater then, the Vapours will riſe higher, and pretty much higher if the Sun ſhines, though in froſty Weather, the Barometer being then very high. If the Barometer falls, and thereby brings the Place of *Æquilibrium* (for Vapours raiſed by the Heat 2) nearer the Earth, then alſo will the Heat be encreaſed, the Vapour more rarefied, and conſequently the new Place of *Æquilibrium* ſufficiently high. It is to be obſerved, that in Winter, when the Heat is only equal to 2, the Air is denſeſt cloſe to the Earth, which has not any Heat ſufficient to rarefy it near the Ground, as happens in warm Weather; therefore the Vapour will riſe gradually in an Air whoſe Denſity decreaſes continually from the Earth upwards; neither will the Vapour be hindered of its full Riſe, by any Condenſation from a greater Cold of the ambient Air, the Air being then as cold next to the Ground where the Vapour begins to riſe, as it is at any Heighth from the Earth.

The Vapour which is raiſed by the Heat of Spring or Autumn expreſſed by Number 3, will riſe to the Height of $3\frac{1}{2}$ Miles, when the Barometer is at 30, and the Air's Rarity is 850. But then, as the Air is hotter nearer the Ground than at the Height of half a Mile or a Mile, the Vapour will condenſe as it riſes; and as the Air, when the Earth is heated, is rarer near the Ground than at ſome Height from it, the Place of *Æquilibrium* for Vapour will, upon

theſe

theſe two Accounts, be brought much lower than otherwiſe it would be; as for Example, to the Height of about a Mile, which will agree with *Phænomena*.

In Summer, the two Cauſes above-mentioned encreaſing, the Vapour raiſed by the Heat 5 (whoſe Place of Æquilibrium would be $5\frac{1}{2}$ Miles high, if the Vapour after it began to riſe was not condenſed by cooling, and the Air was denſeſt cloſe to the Earth) will ſettle at the Height of about $1\frac{1}{2}$ or 2 Miles, which is alſo agreeable to *Phænomena*.

Laſtly, As the Denſity and Rarity of the Vapour is chiefly owing to its Degree of Heat, and in a ſmall Meaſure to the encreaſed or diminiſhed Preſſure of the circumambient Air, when it is not confined; and the Denſity and Rarity of the Air is chiefly owing to the increaſed or diminiſhed Preſſure, by the Accumulation or Exhauſtion of ſuperior Air, whilſt Heat and Cold alter its Denſity in a much leſs Proportion; the Clouds made of the Vapours above-mentioned, inſtead of conforming themſelves to the altered Denſity of the ambient Air, will riſe when it is condenſed, and ſink when it is rarefied; and alſo riſe or ſink (when the Preſſure of the Air is not altered, and its Denſity very little changed) by their own Dilatation, owing to Heat or Cold; as may be obſerved often, by ſeeing them change their Height conſiderably, whilſt the Barometer continues exactly at the ſame Degree, and the Thermometer's Liquor riſes or falls very little, and ſometimes not at all.

As for the Manner how Clouds are changed into Rain, I have hinted it in the Beginning of this Paper; but for farther Satisfaction, I refer the Reader

to

to Dr. *Halley's* Account of it, in the *Philoſophical Tranſactions* (Numb. 183.) in which I entirely acquieſce, having always found it agreeable to the *Phænomena*.

If by publiſhing theſe Thoughts, I have explained the Riſe of Vapours, in a more ſatisfactory Way than has been done before; or if I have only given uſeful Hints to others more capable of doing it, I have my End.

P. S. Since I have, for Brevity ſake, only mentioned at what Heights from the Surface of the Earth, Vapours of different Denſities will come to an *Æquilibrium*, without giving a Reaſon for ſettling the Place of *Æquilibrium*, at thoſe Heights; I think proper to give the Method here by which they are to be found, *viz.* As the Vapours will ſettle and riſe where the Air is of the ſame Denſity with themſelves; it is only required to find the Denſity of the Air at any Diſtance from the Earth, at ſeveral Heights of the Barometer, which may be deduced from Dr. *Halley's* two Tables, *Philoſoph. Tranſact.* Num. 386. (the Firſt ſhewing the Altitude to given Heights of the Mercury, and the Second the Heights of the Mercury at given Altitudes) and knowing the Degree of Heat by the Thermometer, becauſe the Denſity of the Vapour depends upon the Degree of Heat of the Seaſon; provided that proper Allowances be made for the great Rarefaction of the Air near the Earth in hot and dry Weather, and the Condenſation of the Vapours in their Riſe, by reaſon of the Air being colder at a little Height above the Earth than juſt at the Surface of it.

IV. *An Account of ſome Obſervations relating to* Natural Hiſtory, *made in a Journey to the* Peak *in* Derbyſhire, *by Mr.* J. Martyn, *F. R. S.*

THE *Peak* in *Derbyſhire*, having hitherto been deſcribed in ſcarce any other Light, than as a Place compoſed of Wonders; I was not a little deſirous to make ſome Enquiry into the Nature of a Place generally eſteemed one of the moſt Surprizing of our own Country.

In my Way thither, I took Notice of the following Plants, which I have not obſerved to be common

mon in other Parts of *England*, and are not taken Notice of by the Biſhop of *London*, in his Edition of *Cambden*.

Stachys Fuchſii, *J. B.* In the Road to *Grantham*, a little beyond *Coleſworth*.

Scrophularia Scorodoniæ, *folio Mor.* At *Wollerton*, under the Garden-wall. This does not owe its Origine in this Place to Seeds, ſcattered out of the Garden; as I am convinced, by the peruſal of a Manuſcript Catalogue of the Plants cultivated in that Garden, in which there is no mention made of this Plant.

The *Lychnis*, which grows on *Nottingham-Caſtle*, is the *Lychnis ſylveſtris alba* 9 *Cluſii*, and not the ſame with Mr. *Ray*'s *Lychnis major noctiflora Dubrenſis perennis*, as he ſuſpected.

Feſtuca humilior panicula brevi heteromalla. Gramen paniculatum, bromoides, minus, paniculis ariſtatis, unam partem ſpectantibus Raii Syn. On *Sherwood Foreſt*.

Salix folio laureo, ſeu lato glabro odorato Phyt. Brit. Common about *Wingerworth*.

Ladanum arvenſe, flore amplo luteo; labro purpureo. Lamium cannabinum, flore amplo luteo, labio purpureo Raii Syn. In the Corn in ſeveral Places.

Filix mas non ramoſa, pinnulis anguſtis, raris, profunde dentatis Ger. emac. Common about *Wingerworth*.

The *Peak* is famous for ſeven Places, which have been dignified by our Anceſtors, with the Name of Wonders: 1. *Chatſworth*, a magnificent Seat of his Grace the Duke of *Devonſhire*; 2. *Mam-tor*; 3. *Elden-hole*; 4. *The ebbing and flowing Well*; 5. *Bux-*

5. *Buxton-Well*; 6. *Peak's Hole*, and 7. *Pool's Hole*. The Firſt being a Work, not of Nature, but Art, does not come within the Deſign of this Account. *Mam-tor* is a huge Precipice facing the Eaſt, or South-Eaſt; which is ſaid to be perpetually ſhivering and throwing down great Stones on a ſmaller Mountain below it; and that nevertheleſs, neither the one increaſes, nor the other decreaſes in Bigneſs. This Mountain is compoſed chiefly of a Sort of Slate-Stone (called in that Country *Black Shale*) and great Stone. The Nature of the *Black Shale* is known to be, that notwithſtanding it is very hard before it is expoſed to the Air; yet it is afterwards very eaſily crumbled to Duſt. Thus on any Storm, or melting of Snow, this Shale is conſiderably waſted; and as the great Stones are gradually diſengaged, they muſt neceſſarily fall down. That it is only at theſe Times that the Mountain waſtes, is affirmed by the moſt intelligent of the neighbouring Inhabitants: And that this Decay is not perpetual, I can affirm myſelf; having not only taken a cloſe Survey of it, but alſo climbed up the very Precipice, without ſeeing any other ſhivering in the Mountain, than what the treading of my own Feet in the looſe crumbled Earth occaſioned. That the Mountain does not decreaſe in the mean Time, is a Tale too frivolous to need any Conſideration.

Elden-hole, is a huge perpendicular Chaſm. The Depth of it is not known. Mr. *Cotton* tells us, that he ſounded 884 Yards, and yet the Plummet drew. But he might eaſily be deceived, unleſs his Plummet was of a very great Weight; for otherwiſe, I imagine the

the Weight of a Rope of that Length, would be ſo great as to make the Landing of the Plummet ſcarce perceivable. Be that as it will, the Depth of it is to be ſure very conſiderable; and conſidering that we have no where in *England* ſo good an Opportunity of ſearching the Bowels of the Earth to ſo great a Depth; I wonder no curious Perſon has ever had the Courage to venture down. It is ſaid indeed, that a poor Fellow was hired to be let down with a Rope about his Middle, two hundred Yards; and that he was drawn up again, out of his Senſes, and died a few Days after: And no Wonder, for the poor Wretch having nothing elſe to reflect on in that diſmal Place, but the Danger he had put himſelf into for the Sake of a little Money, might probably be fright'ned out of his Senſes. Or indeed the very Fatigue itſelf might put him into that Condition; as any one will eaſily imagine, who has been let down but a quarter of the Way, and drawn up again in that Manner. But I conceive, that if any intelligent and prudent Perſon was to be let down in a proper Machine; he would not be much in Danger, and his Fatigue would be very inconſiderable.

The *ebbing and flowing Well* is far from being regular, as ſome have pretended. It is very ſeldom ſeen by the Neighbours themſelves; and, for my Part, I waited a good while at it to no Purpoſe: And ſo I ſhall paſs it over in Silence.

Buxton-Well has been eſteemed a Wonder, on account of two Springs, one warm and the other cold, riſing near each other. But the Wonder is now loſt, both being blended together. The Spring

which is now uſed for bathing, appears to be 32 ½ Degrees of one of Mr. *Hawksbee*'s Thermometers warmer than the common ſpring Water there *. Statical Experiments on the Effects of warm bathing having been ſeldom made, I hope a few, which I had an Opportunity of making, will not be unacceptable.

		Weight. lb. ʒ.	After bathing 12 Minutes.	Urine.
July 21. 1728. h. 10 ½ at Night.	A.	137 12	137 11 ½	3 ʒ
	B.	134 15 ½	134 13 ½	
	C.	169 15	170 —	
	D.	119 6 ½	119 7	4 ʒ

			Urine. ʒ.	Weight after 1 h.	after bath. 20 Min.
22 h. 8 ½ Morning.	A.	136 9	9 ½	135 15	136 —
	B.	134 1	7	133 7	133 11
	C.	168 13	13	167 11	167 14
	D.	118	15	117 —	117 —

				Perſp.
h. 11. after eat. Cloaths changed.	A.	137 5	After h. 1 ½ Exerciſe chiefly un. Ground in *Pool's Hole*. 1 — lb	10 ½ ʒ
	B.	140 7		13 ʒ
	C.	170 4 ½		
	D.	117 8		8 ½ ʒ

		lb	ʒ	ʒ	Perſpiration in 1 ½ h.
Aft. Din. Cloaths changed.	A.	136	14	3	where note, that all uſed
	B.	142	6 ½	7 ½	moderate Exerciſe, walk-
	C.	170	15	3	ing about, except D, who
	D.	119	1	6 ½	ſate ſtill reading the whole time.

* The Spring Water kept the Spirit of Wine at 41, the Bath Water raiſed it to 8 ½.

Ser-

Servant who attended the Bath.	Weight.	Aft. 1 h. bath.	Aft. 1. h. Perſp.
	lb 3	lb 3	lb 3
	173 4	173 6	172 15

From theſe Experiments may be concluded,

1*ſt*, That warm bathing increaſes the Weight of the Body for the preſent; though it cauſes a plentiful Perſpiration afterwards: Which I do not remember that any one has hitherto obſerved.

2*dly*, That the Perſpiration after this Exerciſe is nothing near ſo large as Dr. *Keill* * has delivered; it amounting by his Account to one Pound and a half in one Hour's Time. By our Obſervation it is but five Ounces in one Hour, and from eight Ounces and a half to one Pound, in one Hour and a half, though aſſiſted by Motion; which might have cauſed us to perſpire (by Dr. *Keill*'s Computation †) from three to ſix Ounces.

Peak's Hole and *Pool's Hole* are two remarkable horizontal Openings under Mountains, the one near *Caſtleton*, the other juſt by *Buxton*. They ſeem to me to have owed their Original to the Springs which have their Current through them. It is eaſy to imagine that when the Water had forced it's Way through the horizontal Fiſſures of the *Strata*, and had carried the looſe Earth away with it, the looſe Stones muſt of

* Med. Stat. p. 16.

† Calore, motu & exercitio unciæ 2 vel 3 interdum 4 perſpiratione unius horæ expelluntur. Med. Stat. p. 15.

Courſe fall down; and that where the *Strata* had few or no Fiſſures, they remained entire, and ſo formed thoſe very irregular Arches which are ſo much wondered at in theſe Places. Whether this be the true Origine of theſe Caves or not, I ſubmit to thoſe who ſhall hereafter have the Curioſity to examine. It ſeems more probable to me, than what others have hitherto propoſed. The three Rivers, as they are commonly called, in *Peak's Hole* are only ſome Parts of the Cave deeper than the reſt, and receiving all their Water from the Spring which comes from the farther End of the Cave. The Water which paſſes through *Pool's-hole* is impregnated with Particles of Limeſtone, and ſo has incruſted almoſt the whole Cave in ſuch a Manner, that it appears like one ſolid Rock.

The more rare Plants which I obſerved in the *Peak* are,

Scariola ſylveſtris Anguillaræ. Lactuca ſylv. murorum flore luteo J. B. On old Walls and about the Entrance into *Peak's-hole*. It grows alſo in *Hertfordſhire*. I chooſe to take Notice of it on this Occaſion, the rather becauſe *M. Vaillant* has evidently miſtaken the Characters of it in his new Diſtribution of the *Cichoraceous Tribe* in the *Memoirs of the Royal Academy of Sciences* for the Year 1721. He there makes it a Species of *Lactuca*, from which it is very different on his own Principles. According to his Method, the *Empalement* of the *Lactuca* is *ſquamous*, and the *Down* of the Seed ſits upon a *Pedicle*. But this Species has a *ſimple Empalement* and a *ſeſſile Down*. Theſe Characters evidently diſtinguiſh it not only from *Lactuca*, but from every *Genus* in his Method. I ſhall take leave therefore to conſtitute a new *Genus*:

And as the Name of *Scariola*, by which *Anguillara* has called it, has not yet been appropriated to any other *Genus*, I ſhall appropriate it to this, and define it, as follows.

Scariola is a *Cichoraceous Plant*, with a *ſimple Empalement*, a *naked Placenta*, and *Seeds* crowned with a *hairy ſeſſile Down*.

Roſa ſylv. alba cum aliquo rubore foliis hirſutis J. B. In ſeveral Hedges about *Hatherſedge*.

Empetrum montanum fructu nigro Tourn. Common on the Mountains.

Oxycoccus, ſeu Vaccinia paluſtria, J. B. On boggy Places, but not very common.

Erica humilis cortice cinereo Arbuti flore albo, H. R. Par. On the Mountains near *Hatherſedge*.

Rubus Idæus ſpinoſus fructu rubro, J. B. In the Hedges.

Geranium ſaxatile Ger. emac. About the Entrance into *Peak's-hole*.

Cochlearia rotundifolia minima Merr. With the preceeding.

Thalictrum minus Ger. In the ſame Place.

Lichenoides ſaxatile, fuſcum, piloſum, varie diviſum. Corallina fuſca folioſa Doody Budd. Hort. ſicc. On the Rocks.

Lichenoides ſaxatile tinctorium foliis piloſis purpureis Dillenii. On the Rocks.

Uſnea ſaxatilis, capillacea. Muſcus corallinus, ſaxatilis, fœniculaceus Raii Syn. On the Rocks near *Darwent*.

Lycopodium Sabinæ facie Fl. Jen. On the Mountains near *Darwent*.

Selago

Selago foliis & facie Abietis Fl. Jen. On the Mountains near *Darwent*.

Bryum Hypnoides capitulis, plurimis erectis lanuginoſum Dillenii. On the Mountains.

Cardamine impatiens altera hirſutior Raii Syn. About the Mouth of *Pool's-hole* plentifully.

A Variety of Mr. *Ray's Viola montana lutea* with a blue and yellow Flower.

The *Lead-mines* in *Derbyſhire* are very various with regard to their Courſes. One into which I went down, had two Branches; one running to the N. E. the other to the N. W. And as I was informed, one of the beſt they ever diſcovered ran due North. Their Breadth and Depth are full as irregular. The Bodies through which they dig to come at the Vein are generally *Limeſtone* and *Black Shale*. But it is uncertain which of the two is uppermoſt. Of two Mines into which I went down, in one they had dug firſt through 26 Yards of *Limeſtone*, then through one of *Black Shale*: In the other firſt through 42 Yards of *Shale*, and then through 28 of *Limeſtone*. The Subſtances which they find mixt with the *Ore*, are

1. *Chert*. This is a kind of *Flint*, which Dr. *Woodward** ſays is called ſo, when it is found in thin *Strata*. But in the *Peak* the *Strata* of *Chert* are often four Yards thick, or thicker. They are found in *Limeſtone*, and not always diſpoſed in *Strata*. Thoſe which I took Notice of were generally either black, or of ſuch a Colour as the inſpiſſated Juice of the *Buck-thorn* Berries, which the Painters call by the Name of *Sap-green*: Whence they are called *Green Cherts* and *Black Cherts*.

* Method of Foſſils, p. 21.

2. *Spar*.

2. *Spar.* This is compoſed of *Cryſtal* mixt with other Bodies. Thoſe which they call *Sugar-ſpars*, are thoſe whoſe Cryſtalliſations are very ſmall, and ſo on crumbling to Pieces have the Appearance of powdered Sugar. I have two Sorts of theſe; white and blue. *Dog-tooth Spar* is a white pointed Spar, in Form and Colour ſomething reſembling Teeth.

3. *Cauk.* This Dr. *Woodward* * ſays is a coarſe talky Spar. But in that Subſtance which I met with in this Country under the Name of *Cauk*; I could not diſcover any Flexibility or Elaſticity, which that learned Writer has ſet down as Characteriſticks of *Talk* and *Talky Bodies.* † It ſeems to me to be nothing but *Spar* incorporated with a coarſe earthy Matter. When this *Cauk* is mixt with pellucid Cryſtalliſations of *Spar*, it is called Baſtard Cauk.

There are ſeveral other Bodies mixt in the Mines with *Lead-ore:* But as they did not occur in thoſe Mines which I examined, I ſhall omit the Mention of them.

When the *Ore* is brought up from the Mine it is broken to Pieces that the *Spar*, *Cauk*, or other Bodies which adher'd to it may be the more eaſily ſeparated. It is then thrown into a large Sieve and waſhed, and ſo farther purified from extraneous Bodies. After this, it is carried to the Furnace in order to be ſmelted. The Furnace, which I ſaw near *Workſworth*, was very rude and ſimple, conſiſting only of ſome large rough Stones, placed in ſuch a Manner as to form a ſquare Cavity, into which the Ore and Coals are thrown *ſtratum ſuper ſtratum*; two great Bellows continually blowing the Fire, being moved alternately by Water. I ſaw

* Method of Foſſils, p. 18. † Catalogue of Foſſils, Vol. i. part i. p. 57.

no

no other Fuel uſed on this Occaſion but dried Sticks, which they call white Coal. * Mr. *Ray* informs us, that they uſe both white and black Coal or Charcoal in *Cardiganſhire*. I ſuppoſe becauſe that Ore is harder to flux; the Charcoal making a more vehement Fire. They generally throw in ſome Spar along with the Ore, which is thought by imbibing the Sulphur to make it flux more eaſily. They frequently throw in alſo ſome Cowke (or Cinders of Pit-coal) becauſe they think it attracts the Droſs, and ſo makes an eaſier Separation of it from the Lead. When the Ore is melted, it runs out at an Opening in the Bottom Part of the Front of the Furnace, through a ſmall Channel made for that Purpoſe, into a cylindrical Veſſel, out of which it is laded into the Mould. The Droſs of the *Ore* on ſmelting is called *Slag*. This *Slag* is afterwards ſmelted again with Cowke only, and the Lead obtained from it is called *Slag-lead*. Their Way of making *Red-lead* is the ſame with † Mr. *Ray*'s Account; only they uſe three Parts of Lead, and one of *Slag-lead*; and think that the *Red-lead* made thus is better than if made without *Slag-lead*.

* Collection of *Engliſh* Words, Ed. 2. p. 174. † Ibid. p. 200.

V. *The*

V. *The Difference in Time of the* Meridians *of diverſe Places computed from Obſervations of the* Eclipſes *of* Jupiter's Satellites, *by the Reverend* Mr. Derham *Canon of* Windſor, *and F. R. S.*

SIR *Thomas Derham*, at *Florence*, having lately favoured me with his Tranſcript of Monſignior *Bianchini*'s Obſervations of the Eclipſes of *Jupiter*'s *Satellites*, from the Year 1721, I have laid them down ſo as to be ſeen at an eaſy View, for the Service of the *R. S.* Monſieur *Bianchini* ſaith, they were made with a Teleſcope of *Campani*'s grinding of 23 ½ *Roman* Palms: That Father *Jo. Bapt. Carboni* at *Lisbon* made uſe of ſuch another of the ſame Make, Length, and Goodneſs; and therefore thinks the Times aſſigned by them, to be exact; that he drew *Meridian-Lines* at *Aſſiſi in Ombria & Urbino*; at St. *Quirico* in *Tuſcany* and *Florence*: And that Monſignior *Euſtach. Manfredi* at the Obſervatory of *Bologna*, and he obſerved the Immerſion of the firſt *Satellite* on 25 *Auguſt* within two Seconds of one another; *Manfredi* with a Glaſs of 8 *Bononia* Feet, and he with one of 11; both made by *Campani*. With his own, *Bianchini* hath inſerted ſome Obſervations, made at the ſame time by Father *Carboni* at *Lisbon*, and Father *Grammatici* at *Ingolſtad*; Monſieur *Maraldi* at *Paris*, and Monſignior *Euſtachius Manfredi* at *Bologna*; as alſo an Immerſion obſerved by Mr. *Molyneux* near *London* (I ſuppoſe at *Kew*) with his reflecting Teleſcope, and two at *Pekin* in *China* by Father *Ignatius Kogler* a *Jeſuit*: But I ſuppoſe there is a Miſtake in the Obſervation of *November* 30, 1724, that it was an Emerſion, not an Immerſion; the Immerſions of the firſt *Satellite* being not to be ſeen then.

Sir *Thomas* tells me that Signior *Bianchini* promiſeth his Obſervations of the circumjovial Eclipſes from the Year 1700, and that he will ſend the Society in *November* his new Globe of *Venus*.

As to the *Bologna* Obſervations, they were put into my Hands by Dr. *Rutty*, Secr. to the *R. S*; and are ſaid to be made with a Glaſs of *Campani*'s, of 11 *Bologna* Feet. And to ſave the Peruſor the Trouble, I have computed the Difference in Time between the Places in *Bianchini*'s and *Manfredi*'s Catalogues, and ſome Obſervations that I had of mine own.

Rome and *Liſbon*.		
H.	′	″
1	24	46
1	25	34
1	26	34
1	29	0
1	26	44
1	26	54
1	28	11

Rome and *Paris*.		
0	39	48
0	40	50
0	36	16
0	38	56
0	40	17

Rome and *Ingolſtad*.		
0	2	51
0	4	1

Rome and *Bologne*.		
0	3	45
0	2	16
0	4	45
0	4	14

Rome and *Kew*.		
H.	′	″
0	45	47

Rome and *Wanſted*.		
0	49	10

Rome and *Upminſter*.		
0	47	28

Rome and *Southwick* in *Northampton-ſhire*.		
0	47	58

Urbino and *Liſbon*.		
1	28	57

Paris and *Liſbon*.		
0	45	46
0	45	44

Paris and *Bologne*.		
0	34	30
0	34	0
0	38	32

Ingolſtad and *Liſbon*.		
H.	′	″
1	22	53
1	23	21

Ingolſtad and St. *Quirico*		
0	1	20
0	1	40

Ingolſtad and *Bologne*.		
0	1	53

Ingolſtad and *Paris*.		
0	36	23
0	36	00

Ingolſtad and *Upminſter*.		
0	46	10

St. *Quirico* and *Liſbon*.		
1	22	30

St. *Quirico* and *Paris*.		
0	37	40

St. *Quirico* and *Upminſter*.		
H.	′	″
0	47	50

Florence and *Liſbon*.		
1	19	43

Florence and *Bologne*.		
0	0	31

Florence and *Upminſter*.		
0	42	1

Upminſter and *Bologne*.		
0	43	43

Upminſter and *Liſbon*.		
0	37	42

Bologne and *Liſbon*.		
1	21	28

Bologne and *Albano*.		
0	3	43

Ob-

Obſervations of the Eclipſes of *Jupiter*'s *Satellites* made by Monſignior *Bianchini* at *Rome*, and other Places: With Accounts of ſuch as he received from other Places.

Days of the Month.	Time of Obſervation.	Satel. Eclip.	Place where obſerved.
	Anno Domini 1721.		
	H. ′ ″		
Apr. 3	15 4 32	Im. 1	At *Rome*.
Jun. 21	8 46 0	Em. 1	*Rome*.
	Anno Domini 1722.		
Jun. 9	13 20 0	E. 1	*Rome*.
— 18	9 36 30	E. 1	At *Albano*.
Jul. 11	9 49 10	E. 1	*Rome*.
— 27	8 7 30	E. 1	*Rome*.
Aug. 19	8 26 20	E. 1	*Rome*.
	Anno Domini 1723.		
Apr. 26	17 14 50	I. 1	*Rome*.
May 11	15 31 45	I. 1	*Rome*.
— 3	15 48 51	I. 1	*Rome*.
	15 43 0		At *Ingolſtad* by F. *Grammattici*.
— 27	18 56 0	I. 1	*Rome*.
Jun. 5	12 16 30	I. 1	*Rome*.
12	14 11 39	I. 1	*Rome*.
23	9 11 40	E. 1	*Rome*.
	7 46 0		*Lisbon*, by Fa. *Carboni*.
30	11 7 20	E. 1	*Rome*.
Jul. 8	7 32 0	E. 1	At *Ocricoli* in *viâ flaminiâ*.
15	9 35 0	E. 1	At *Aſſiſi* in *Ombria*.
7	9 50 45	E. 1	*Urbino*.
	8 21 48		*Lisbon*.
23	8 17 54	E. 1	At *Muceria* in *Ombria*.
Aug. 16	8 36 10	E. 1	At *Albano* in the *viâ appiâ*.

Days of the Month.	Time of Obſervation.	Satel. Eclip.	Place where obſerved.
	Anno Domini 1724.		
	H. ′ ″		
Jun. 8	14 3 28	I. 1	*Carboni* at *Lisbon*.
15	15 56 27		
23	13 42 50		*Rome*.
30	15 34 29	I. 1	*Rome*.
	14 8 55		*Lisbon*.
Aug. 10	10 45 20	E. 1	*Rome*, but doubtful.
17	12 40 45	E. 1	*Rome*.
26	9 6 45	E. 1	*Rome*.
Sep. 11	7 30 53	E. 1	*Rome*.
18	9 28 16	E. 1	*Rome*.
25	11 25 55	E. 1	*Rome*.
	9 59 21		*Lisbon*.
Oct. 11	9 53 8	E. 1	*Albano*.
14	9 31 0	E. 3	From the *Limb* of 4 into 4 Shadow.
	11 7 0	I. 3	*Albano*.
	— 9 30		
Nov. 27	8 16 0	E. 1	*Albano*.
12	5 33 10	E. 1	*Rome*.
19	8 25 5	E. 1	*Rome*.
30	6 14 0	I. 1	At *Pekin* in *China*, by F. *Kogler* the *Jeſuit*.
Dec. 5	6 42 25	E. 1	*Rome*.
	Anno Domini 1725.		
Jun. 19	15 17 10	I. 1	*Rome*.
July 5	13 32 20	I. 1	*Albano*.
7	14 55 30	I. 1	*Pekin*.
21	11 45 22	I. 1	*Rome*.
	10 89 35		Mr. *Molineux* near *London*.
28	13 39 10	I. 1	*Rome*.
	12 12 26		*Lisbon*.

Day of the Month.		Time of Observation. H. ′ ″	Satel. Eclip.	Place where observed.
				Rome.
Nov.	15	9 53 50	E. 1	Lisbon.
		8 24 50		
——	24	6 15 15	E. 1	Rome.
Dec.	17	6 20 30	E. 1	Rome.
		Anno Domini 1726.		
		13 28 46		Rome.
Jul.	17	13 24 45	I. 1	Ingolstad.
		12 1 52		Lisbon.
		11 40 0		St. Quirco in
Aug.	2		I. 1	Tuscany.
		11 41 20		Ingolstad.
		13 36 0		Siena in Tus-
——	9		I. 1	cany.
		12 13 30		Lisbon.
		15 28 29		Florence.
——	16	14 8 46	I. 1	Lisbon.
		15 29 0		Bologne.
		11 54 24		Bian. } At
		11 54 26		Man. } Bol.
Aug.	25	11 56 18	I. 1	Ingolstad.
		11 19 55		Paris.
		10 32 57		Lisbon.
		8 41 0		St. Quirico.
Sep.	26	8 39 20	I. 1	Ingolstad.
		8 3 20		Paris.
Oct.	1	16 7 45	I. 1	St. Quirico.
Nov.	20	7 46 30	E. 1	Rome.
		6 20 19		Lisbon.
——	27	9 39 25	E. 1	Rome.
		6 0 16		Rome.
Dec.	6	5 58 0	E. 1	Bologne.
		5 24 0		Paris.
		Anno Domini 1727.		
Mar.	8	6 42 50	E. 1	Rome.
		15 18 27	I. 1	Rome.
Aug.	5	15 0 8	I. 2	Rome.
		14 21 12		Paris.
		12 0 0		Rome.
Sep.	6	11 55 15	I. 1	Bologne.
		11 19 43		Paris.
Oct.	15	10 41 30	I. 1	Albano.
——	20	6 5 54	I. 1	Albano.
——	22	12 33 23	I. 1	Albano.

Day of the Month.		Time of Observation.	Satel. Eclip.	Place where observed.
		Anno Domini 1728.		
Jan.	15	13 13 46	E. 1	Rome.
Feb.	16	9 46 56	E. 1	Rome.
Mar.	26	8 32 7	E. 1	Rome.

Observations made at the Observatory of Bologne, by Monsignior *Eustachius-Manfredi.*

		Anno Domini 1726.		
Aug.	16	15 29 0	I. 1	Dubious.
——	25	11 54 24	I. 1	Dubious.
Nov.	27	9 35 11	E. 1	Dubious.
Dec.	4	11 27 45	E. 1	Dubious.
——	26	5 47 4	I. 3	Dubious.
——		7 56 23	——	The third b
——		29 59 26	E. 1	gan to merge.
——	31	6 18 54	E. 2	Just begun.
		Anno Domini 1727		
Jan.	2	9 45 27	I. } 3	Dubious.
		11 53 38	E. }	
——	5	7 51 54	E. 1	
——	7	8 54 12	E. 2	
Feb.	7	5 50 5	I. } 3	Dubious.
		7 52 54	E. }	
——	8	8 37 59	E. 2	Air thick.
Aug.	21	13 34 39	I. 1	
Sep.	6	11 55 17	I. 1	
——	17	10 48 59	I. } 3	
		12 40 30	E. }	
Oct.	13	16 5 45	I. 1	
——	22	12 29 42	I. 1	
——	23	8 55 34	E. 3	
——	30	11 1 9	I. 3	Dubious.
Nov.	5	9 5 15	I. 2	Dubious.
——	30	8 44 13	E. 2	
		Anno Domini 1728.		
Jan.	17	8 41 8	E. 3	
Feb.	16	9 43 11	E. 1	
——	29	6 40 45	I. } 3	Dubious.
		8 50 40	E. }	

VI. *Extract of a Letter to the* Publiſher *from Monſ.* De Liſle, *Aſtronomer Royal at* Petersburgh, *containing his Obſervations of the Eclipſes of* Jupiter's Satellites *from* July 10th, 1726, *to* April 12th, 1728, taken at that Place.

Petersburgh, *July* $\frac{2}{12}$, 1728.

SIR,

I Send you at preſent all the Obſervations of the *Satellites* of *Jupiter* that I have made here the two laſt times of his Appearance; and I don't queſtion but there will be Number ſufficient to ſettle the Difference of our Meridians, by comparing them with the Obſervations made in *England*. The following were made with common Teleſcopes of 13, 15, 20½, and 22 Foot; and are very good ones ——

1726.	D.	H.	′	″	*What Eclipſe.*		*Teleſcope.*	
July	10	12	47	0	Im. of the 1ſt.		15 Foot.	a little doubtful.
Aug.	9	14	51	30	Immer. —	1	15 and 22	doubtful near 15″.
	18	11	15	46	Immer. —	1	15 —	
		11	15	52	Immer. —		20 ½ —	
Sep.	10	11	32	51	Immer. —	1	15 —	
		11	32	56	Immer. —		20 ½ —	
	22	16	13	20	Immer. —	2	15 —	
Oct.	19	12	21	46	Em. —	1	15 —	
	28	8	47	8	Em. —	1	15 —	to ſome ″.
Dec.	6	7	11	18	Em. —	1	20 ½ —	ſomewhat doubtful.
		10	30	31	Em. —	2	20 ½ —	exact.
		10	30	38	Em. —		15 —	exact.
	29	7	15	36	Em. —	1	20 ½ —	exact.
		7	15	48	Em. ——		15 —	exact.
1727.								
Jan.	2	10	59	46	Immer. —	3	15 —	Air foggy.
		11	0	17	Immer. ——		20 ½ —	

	D.	H.	′	″	Wher Eclipſe.		Teleſcope.		
	7	10	9	56	Emmer.	— 2	20 ½	Foot.	
		10	10	4	Em.	—	15	—	
Feb.	1	7	17	15	Em.	— 2	20 ½	—	exact.
Aug.	5	11	52	23	Immer.	— 3	22	—	to a few ″
	7	10	59	27	Immer.	— 1	22	—	♃ was low.
	8	13	37	9	Immer.	— 2	22	—	
	21	14	50	30	Immer.	— 1	22	—	
	30	11	19	18	Immer.	— 1	22	—	
Sep.	2	10	43	57	Immer.	— 2	22	—	
	6	13	11	24	Immer.	— 1	22	—	doubtful.
	9	13	21	35	Immer.	— 2	22	—	
	10	9	34	30	Emmer.	— 3	22	—	
	15	9	36	32	Immer.	— 1	22	—	
Oct.	31	10	8	48	Immer.	— 1	15	—	doubtful.
Dec.	2	8	46	30	Em.	— 1	22	—	
	12	14	6	0	Em.	— 3	22	—	
1728.									
Jan.	8	12	14	44	Em.	— 2	15	—	to ſome ″
		12	33	34	Em.	— 1	13	—	ſomewhat doubtful.
	10	5	58	7	Em.	— 3	22	—	to ſome ″
		7	0	12	Em.	— 1	22	—	the wind incommoded.
	17	7	56	31	Im.	— 3	13	—	exact.
		8	53	4	Em.	— 1	22	—	
		9	55	14	Em.	— 3	22	—	
Feb.	16	10	59	26	Em.	— 1	22	—	to ſome ″
	18	5	28	20	Em.	— 1	15	—	the day not cloſed.
	27	6	40	5	Em.	— 2	22	—	
	29	8	0	29	Immer.	— 3	22	—	the *Satellite* appeared and diſappeared at different Times.
Mar.	10	11	18	19	Em.	— 1	13 and 15		
Apr.	12	8	16	12	Immer.	— 3	15	—	
		10	30	40	Em.	— 3	15	—	♃ was low.

I am, *&c.*

DE LISLE.

FINIS.

Numb. 408.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *March* and *April*, 1729.

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I. QUERIES, *concerning the Cauſe of Coheſion of the Parts of Matter, propoſed in a Letter to Dr.* Deſaguliers, *F. R. S. By* Fr. Triewald, *Director of Mechanicks in the Kingdom of* Sweden.

II. *A Letter to Dr.* Rutty, *R. S. Secr. giving a farther Account of the Nature and Virtues of the* Holt-Waters, *from the Reverend Mr.* J. Lewis, *Vicar of the Place.*

III. *A farther Account of a new Machine, called the* Marine Surveyor, *deſigned for the Menſuration of the Way of a Ship at Sea, more correctly*

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rectly than by the Log, *at present in Use, or any other Method hitherto invented for that Purpose. By Mr.* Henry de Saumarez, *of the Island of* Guernsey, *Part of his Majesty's antient Dutchy of* Normandy.

IV. *A second Letter from Mr.* Colin Mc Laurin, *Professor of Mathematicks in the University of* Edinburgh *and F. R. S. to* Martin Folkes, *Esq; concerning the Roots of Equations, with the Demonstration of other Rules in Algebra; being the Continuation of the Letter published in the* Philosophical Transactions, N° 394.

Jos: Banks

LONDON:

Printed for W. INNYS, at the *West-End* of St. *Paul's Church-Yard.*

I. QUERIES, *concerning the Cauſe of Coheſion of the Parts of Matter, propoſed in a Letter to Dr.* Deſaguliers, *F. R. S. By* Fr. Triewald, *Director of Mechanicks in the Kingdom of* Sweden.

Stockholm, Novem. 20. 1728.

Reverend SIR,

HAVING lately received the *Tranſactions* of the *Royal Society*, publiſhed ſince I left *England*, in order to ſettle in my native Country, I find you have been pleaſed, in *Numb.* 389, to take Notice of my Experiments made concerning the Coheſion of two Balls of Lead; and as I don't know any Body has aſſigned the true Cauſe of this Phænomenon, I beg you'll be pleaſed to propoſe the following *Queries* to that illuſtrious Society of which you are a worthy Member.

Query I. Does not this ſtrong Coheſion of two Balls of Lead prove the Doctrine of Attraction, worthy its great Author, your late Preſident Sir *Iſaac Newton*; and that there is a univerſal Attraction between the Parts of Matter in Nature, though ſome at ſuch ſmall Diſtances as to eſcape our Obſervations, ſince we cannot make their Parts touch one another cloſe enough, ſo as to come within their Sphere of Activity? Which I preſume to be the Reaſon why I never have been able to make Balls of any other Metals to cohere: Nor do I believe that the Parts of any other Metal can come to ſuch a cloſe Contact, except by Fuſion, as the Particles of Lead may, by

being ſo many Degrees ſofter than thoſe of any other Metal.

Query II. I have often found the touching Surfaces of ſuch Leaden Balls, as near as I could meaſure, much alike; yet the Force of Coheſion very different: Nay, I have found the touching Surfaces very ſmall, yet ſometimes 114 to 126 ℔ Weight has not been ſufficient to ſeparate them; when at other Times a far leſs Weight (though the Meaſure of touching Surfaces far exceeded thoſe mentioned) was more than ſufficient to cauſe their Separation. Does it not prove that the Coheſion is ſtrongeſt according to the cloſeneſs of the Contact, but not as the touching Surfaces? For which Reaſon I always have found the Coheſion ſtrongeſt, when I gave a little twiſt in joining them; ſince by this Means the Particles muſt come cloſer together, than by ſqueezing the Balls barely on one another, though it was done with a far greater Force than I could apply with my bare Hands. And ſince the Force, Twiſt, and touching Surfaces can never be alike and menſurable when joined by Hand, I think it will be very difficult, if not impoſſible to aſcertain the Forces of this Coheſion, which is incredible, and far exceeds Magnetical Attractions.

That the Preſſure of the Atmoſphere contributes little, and next to nothing in this Coheſion, I have fully proved and experienced laſt Winter, before a great and noble Aſſembly at my Lectures held in this Place: The Coheſion of two Leaden Balls, which 126 ℔ could not ſeparate, prov'd as ſtrong in *Vacuo*, as in the open Air.

Query

Query HI. Does not this Experiment fairly account for the Cohesion of the Parts of Matter; and that this firm Cohesion cannot be derived from any Glue or Cement, any imaginary Hooks and Funiculus, nor *de gravitate Ætheris*: but that the Particles of all solid and fluid Bodies do attract one another by a certain Force (whatever be the Cause of the same) which acts most intensely the nearer they touch one another.

I am confirmed in this Opinion by an Experiment I made this Summer at *Dannemora*, one of the most considerable Iron Mines, and where I have erected the first and largest Fire-Engine for drawing Water and Oar in this Kingdom; the Cylinder being two Lines more than thirty-six Inches in Diameter.

Our *Dahlkarlians* have, Time out of Mind, practised the said Experiment, when they have had Occasion to remove any unweildy Stones of the hardest Rocks, and so big as not to be moved entire by any Strength they could apply. They practise the following Means, not only to cleave and split them in as many Parts and Pieces as they please, but they obtain Stones with one or more smooth Sides, fit for Use in Buildings. Their Method is thus.

They take Tallow, Greese, Train Oil, or any other fat Substances, and draw Lines on such large Stones, according as they would have them split, and think proper; then they lay either Char-Coal or Wood at Top, and round the Sides of the Stone, so that it is all over covered, and then kindle the Fuel; which when burned out, they find the Stone divided according to the Lines they have drawn on the same,

with ſome of the before-mentioned fat Subſtances, which ſeldom or never fails.

May one not account for this odd *Phænomenon* thus? That as the Action of Heat and Fire exſpands the Parts of all hard and ſolid Bodies and Metals themſelves, ſo when the Action of the Fire about the Stone has made the Particles of the ſame recede farther from one another, than when in their natural State, the oily Subſtances inſinuate themſelves more and more between the Particles of the Stone; by which Means, when the Stone cools again, and ſhrinks, they ſeem to prevent theſe Particles from coming as cloſe, and within their Sphere of Activity, as the remainder Particles may, where no ſuch foreign Matter has been applied; by which Means they alſo cannot attract one another ſo ſtrongly as the reſt, and muſt therefore remain ſeparated.

Fat and oily Subſtances ſeem to be moſt fit for this ſame Purpoſe, ſince they are endued with a repelling Force.

I can't but admire, that notwithſtanding ſo many *Phænomena* in Nature prove a Tendency and a ſtrong mutual Attraction of the Parts of Matter, whatever be the Cauſe, yet moſt learned Men, of ſeveral Nations, would rather charge ſuch manifeſt Qualities and Operations of Nature with the Nick-Name of occult Qualities, than give the Honour to the *great Diſcoverer (who is no more)* of thoſe manifeſt Qualities and Principles of Motion. However, I am confident, that as Nature is very uniform and agreeable to herſelf, ſhe'll evince the Truth of her Operations.

If

If I find you pardon this Liberty I have taken by this, it will encourage me to tranſmit ſeveral Experiments and Obſervations I have lately made, remaining with the utmoſt Sincerity,

Moſt Reverend SIR,

Your moſt obedient humble Servant,

F. Triewald,
Director of Mechanicks in the Kingdom of Sweden.

II. *A Letter to Dr.* Rutty, *R. S. Secr. giving a farther Account of the Nature and Virtues of the* Holt-Waters, *from the Reverend Mr.* J. Lewis, *Vicar of the Place.*

SIR,

IN a Letter I received lately from Mr. *Brome*, he gave me an Account that he had communicated to you a Paper of mine, relating to the Mineral Waters at *Holt*; and that you had ſent it to the Preſs among the *Philoſophical Memoirs* of the *Royal Society*; which I was pleaſed to hear, becauſe I hoped it might be a Means to raiſe the Eſteem of the Waters, and recommend them to the good Opinion of the learned World. He likewiſe informed me, that you was willing to enquire into ſome further Particulars relating to thoſe Waters.

This Intimation of yours to Mr. *Brome* has drawn upon you the Trouble of this Paper; being willing to

to make known, as far as lies in me, the excellent Virtues of theſe Waters, of which I have been an Eye-witneſs for ſeveral Years in many extraordinary Cures.

Experience has proved them of admirable Efficacy in Scorbutick and Scrophulous Caſes: wherein they have done ſuch Wonders, that a ſhort Account which was publiſhed of their Cures in that Kind, about five Years ago, was looked upon by ſome, rather as a romantick Tale, than a true Narrative of real Facts.

They are of an attenuating, aſtringent and drying Nature: And by theſe Qualities, I imagine, they perform their Cures. The firſt is the known Property of all Water, to dilute the Blood, and thin the Juices, and thereby to fit them to paſs the fine Strainers, and be carried out of the Body by their proper Drains. In the Second conſiſts the great Excellence of *Holt-Water*, which, by its notable Aſtringency, braces the Solids, ſtimulates the Fibres, and quickens their contractile Power, and thereby enables them to ſhake off, protrude and ſqueeze out ſuch Feculencies, as may adhere to, clog and ſtuff them up. And this Quality, it is probable, they derive from the Allom and Iron that are ſuppoſed to impregnate them. The Ingredients, which give them their drying, abſorbing and healing Quality, are the Sulphur and Ochre; by which they imbibe the peccant Humours, and ſheath the ſharp Salts, that lance and tear the finer Glands, and cauſe Blotches, and Ulcerations. As they attenuate and aſtringe, they are a noble Diuretick, removing Obſtructions from the Kidneys, and cauſing the Renal Glands to make their due Secretions, and at the ſame

Time

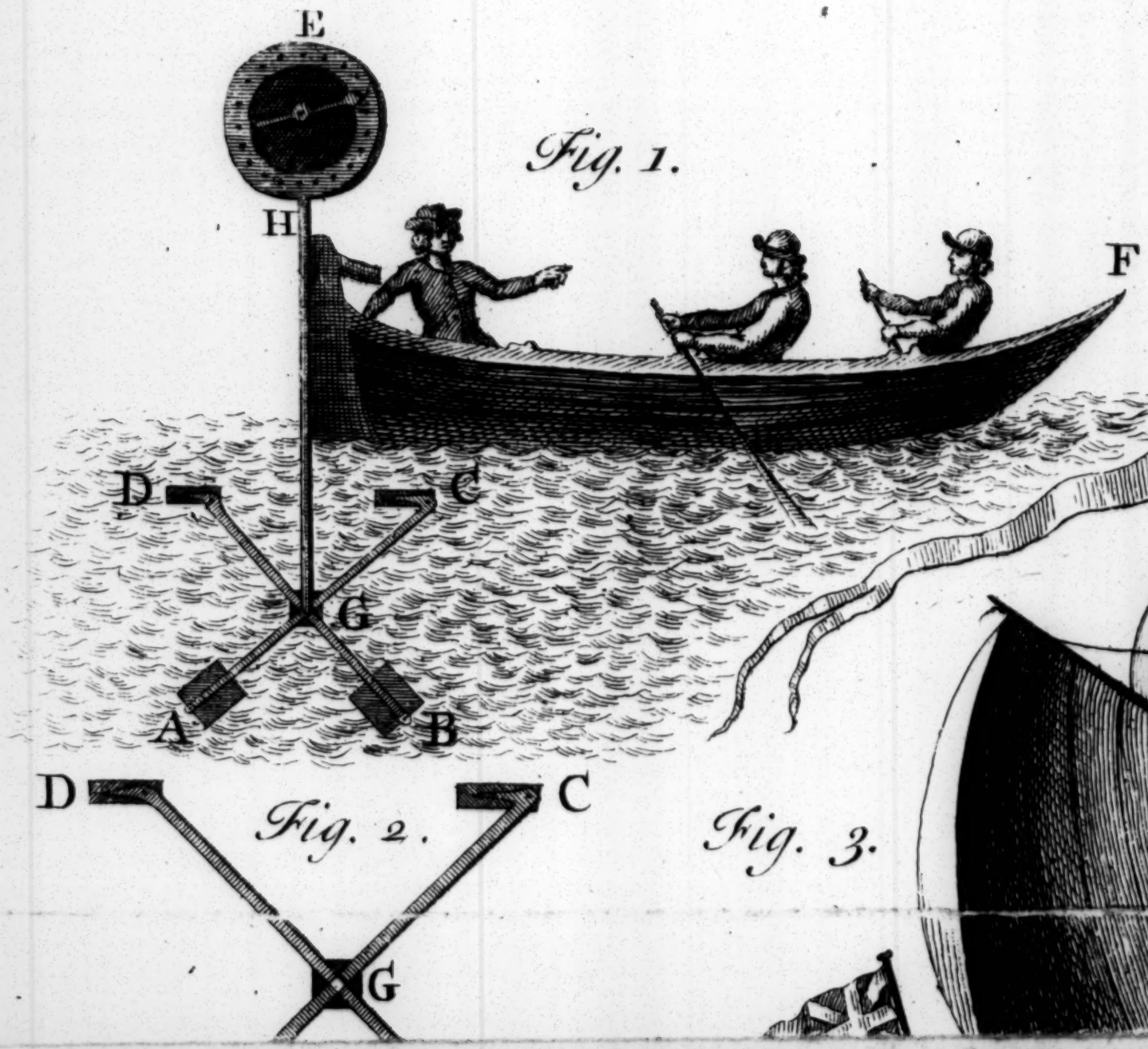


Fig. 1.

Fig. 2.

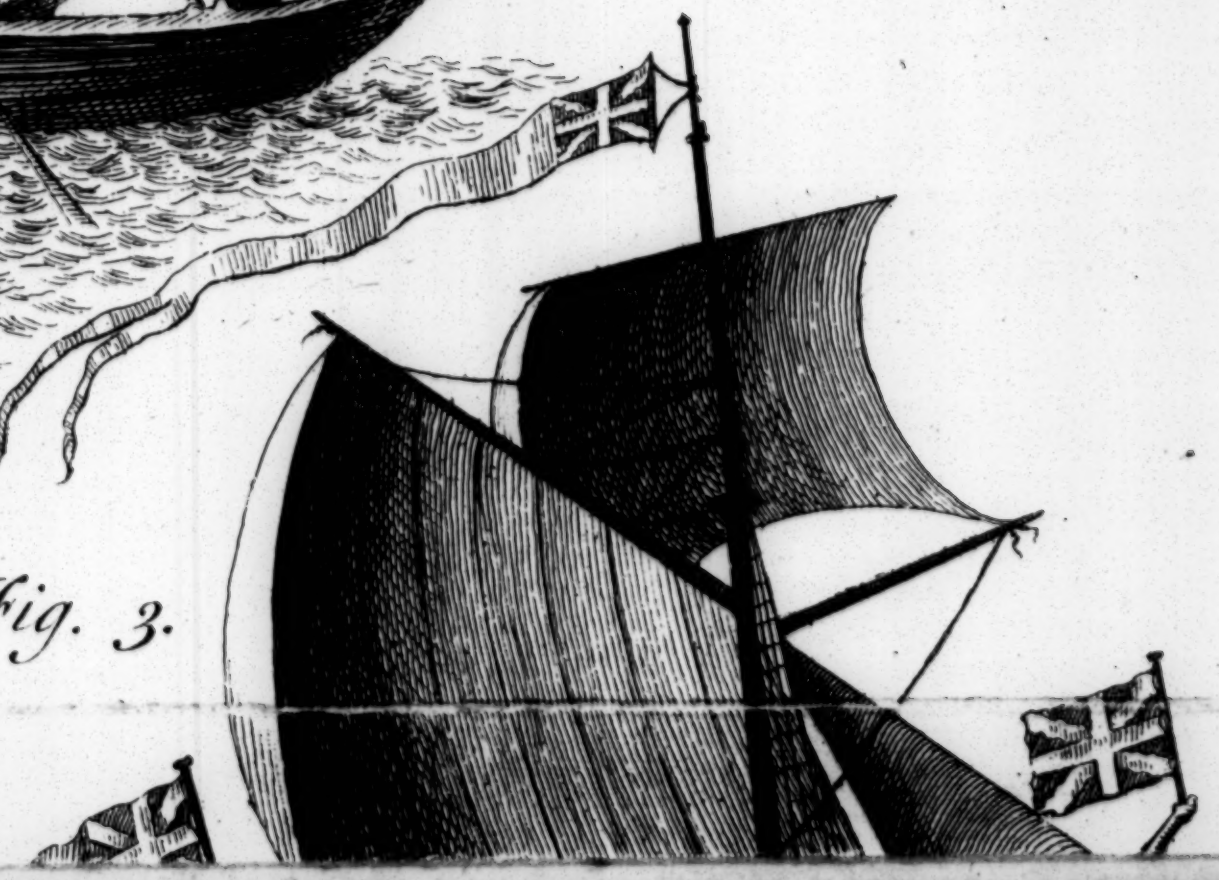


Fig. 3.

Fig. 1.

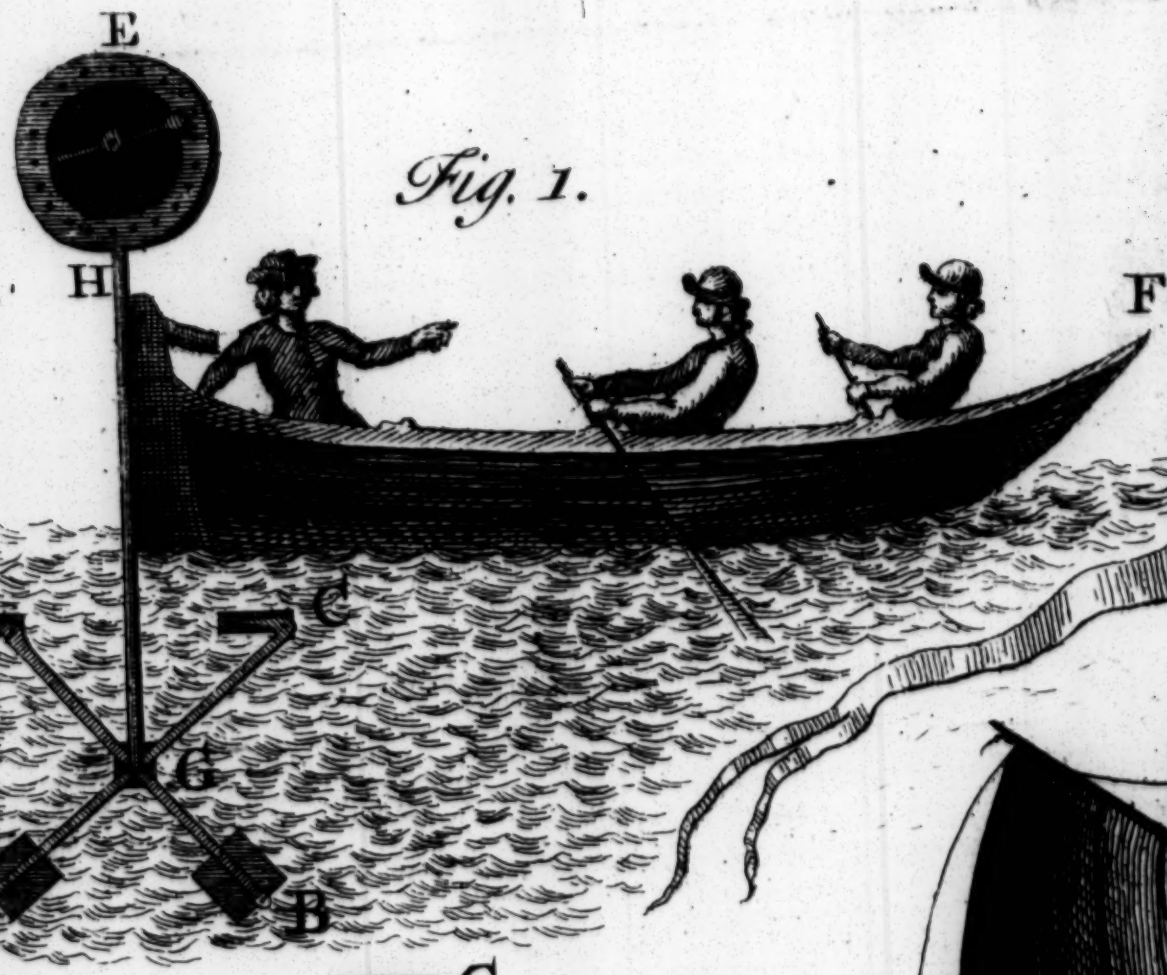
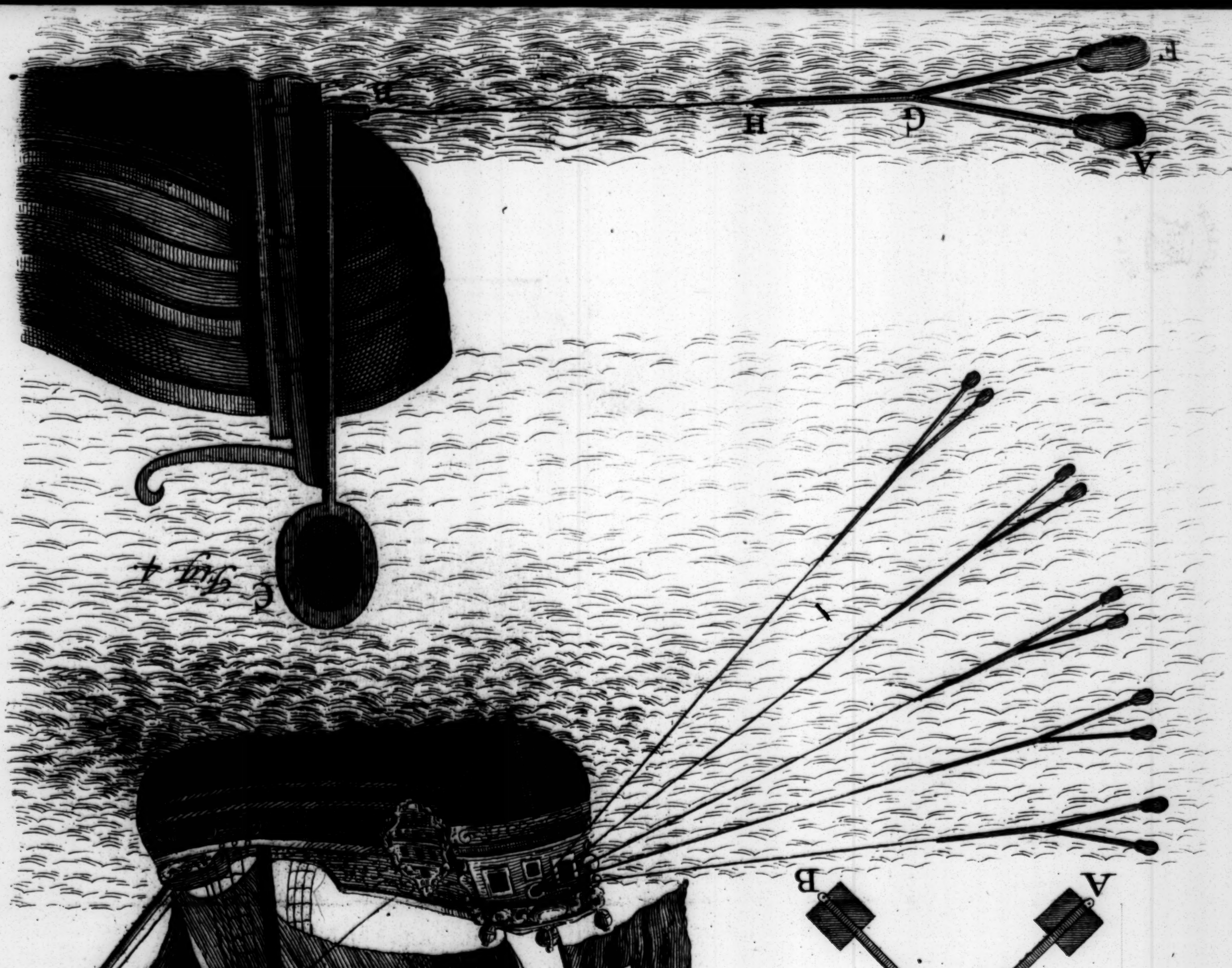


Fig. 2.

Fig. 3.


E
H
G
A
Fig. 4.
A
B

A

B

C Fig. 4.

A

G

H

B

F

Time diſſolving the groſſer Salts, and fitting them to be carried off through the Urinary Paſſages.

Theſe Waters have been found of excellent Avail in many other Illneſſes, beſides the Scurvy and Evil: But I forbear mentioning any other Caſes, leſt I treſpaſs againſt good Manners, by making my firſt Viſit too long. I am with all due Reſpect,

SIR,

Your very humble and obedient Servant,

Holt, Dec. 16. 1728.

John Lewis.

III. *A further Account of a new Machine, called the* Marine Surveyor, *deſigned for the Menſuration of the Way of a Ship at Sea, more correctly than by the* Log, *at preſent in Uſe, or any other Method hitherto invented for that Purpoſe. By Mr.* Henry de Saumarez, *of the Iſland of* Guernſey, *Part of his Majeſty's antient Dutchy of* Normandy.

HAVING given an Account of my Projection for aſcertaining the Run of a Ship at Sea, which has appeared in the *Philoſophical Tranſactions* of the *Royal Society*, Vol. xxxiii, for the Months of *November* and *December* 1725; as alſo in thoſe for the Months of *March* and *April* 1726;

and having been ſince frequently employed in making Experiments thereof, and Improvements thereon, I take Leave to add what follows as a Supplement to thoſe Diſcourſes on this Invention, which I am humbly of Opinion may, in Time, prove of great Uſe in thoſe extenſive Branches of our foreign Commerce, wherein ſo many of his Majeſty's Subjects are concerned.

At my publickly ſetting out on this Invention, I had his late Majeſty's Leave ſeveral Times to have a Boat on the Canal in St. *James*'s *Park*, where the Shallowneſs of the Water was ſuch, that it would not admit of my uſing the Iron Fork, the Weight of which may be about four Pounds, and which I have deſcribed in the *Tranſactions* afore-mentioned; and therefore I was obliged to fall on ſome Expedient to anſwer my Purpoſe in ſuch a Depth of Water. Various were my Deſigns to this End; however at length I fixed ſuch a Machine to my Boat, as had an equal Number of Revolutions in a meaſured Diſtance of 2000 Feet, even though the Boat went ſwift or ſlow; of which the Reverend Dr. *Deſaguliers*, and ſome other Mathematicians, at Times, were Witneſs. As I did not deſcribe this Inſtrument in the former Account of my Machine, where it ſeems to lie blended with that of the Fork, I ſhall give a Deſcription of it here in the following Figures, *viz.*

In

In the Firſt of theſe Figures, F repreſents my Boat on the Canal in St. *James*'s *Park*, through the Rudder of which a ſmall Spindle paſſes (in an Iron Pipe) of which H G is the Length. To the Point G are faſtened the four Iron Fins, or Flyers, A, B, C and D, in the Form of a Square, the Bars D B and A C, to which they are fixed, lying in an horizontal Poſition. Theſe Flyers are ſo contrived as to have full Play in any Motion of the Boat. To the Point H, which is the upper Part of the Pipe and Spindle, is fixed the Dial E: Now the Boat being put into Motion, the Flyers move accordingly, which proportionally affecting the Spindle, the Motion is thereby communicated to the Dial, which may be fitted to ſtrike the Miles or Leagues that the Veſſel runs.

But to deſcribe the firſt Movement of this Machine more exactly, *Fig.* 2. repreſents it unfixed. The Croſs, or Bars D B and A C, as I ſaid before, lie flat, or in an horizontal Poſition; the Arbor or Spindle, which is perpendicular thereto, ſcrews into the Point G, and paſſes through an Iron Pipe to the Dial, in manner aforeſaid. The Flyers A, B, C and D being fitted to move in any Motion of the Boat, the Bars are accordingly affected. This Inſtrument is ſo contrived, that two of the Flyers on one Side ſhall always reſiſt the Water in the Motion of the Veſſel, whilſt the other Two give Way in their Turning. The reſiſting Flyers in this Figure are A and B, and D and C will be the ſame when they come into their Poſition; for they reſiſt and give Way alternately ſo long as the Motion continues, which is always circular; and ſo truly does it revolve, that

be the Motion ſwift or ſlow, in any meaſured Diſtance, the Number of Revolutions will be equal.

This is the Machine which I firſt tried on the Canal in St. *James*'s *Park*, and with this it was, that I made my Obſervations on the Tides in the River *Thames*, as they appear in the *Philoſophical Tranſactions* for the Months of *March* and *April* 1726; which I choſe the rather to do, in regard I found it to anſwer very well in all my Experiments. And I am yet of Opinion, that it would be an uſeful Inſtrument to determine the Strength of the Tides on our Sea Coaſt, which if marked in our Charts, might prove advantageous to our Commerce. But conſidering, that though this Projection might be ſerviceable in Barges, Pleaſure-Boats, or other Veſſels, in fair and moderate Gales of Wind, yet it might prove uſeleſs in boiſterous and ſtormy Weather, and in long Voyages, when it might be choaked with Weeds; I therefore fixed to my other Invention the Fork, which is contrived in ſuch a Manner, that I will even yet be ſo bold as to affirm, it ſhall determine the Ship's Way in a Storm, or when ſhe is ſcudding before the Wind, when the *Log* is incapable of it. As the Canal would not allow me to try, with any Certainty, my Iron Forks there, I was obliged to have ſome made of lighter Materials, which ſeemed to anſwer ſomewhat near the Truth, and made me ſo ſanguine as to believe, that they would have an equal Number of Revolutions in the ſame Diſtance, even though the Motion of the Boat was ſwift or ſlow between Mark and Mark. I muſt here do my worthy Friend Dr. *Deſaguliers* (who frequently honoured me with his Company in the Experiments of the

aforeſaid Invention) the Juſtice to own, that he diſſented from me in this Particular, in regard he ſaid the Forks muſt have different Poſitions, according to the Velocity of the Veſſel to which they were fixed, and conſequently could not have an equal Number of Revolutions in ſwift and ſlow Motion.

Whilſt I was conſidering where to carry on my Experiments to prove the Verity of my Inſtrument, and to anſwer this Objection, I had the Honour to be introduced to the late ingenious *Samuel Molyneux*, Eſq; whoſe Memory will always remain dear to me. As he was ever ready to encourage all laudable Deſigns, and particularly ſuch as were calculated for Publick Good, he ſoon became my Patron: And as he was then one of the Lords Commiſſioners of the Admiralty, and my Machine fell within his Province, he expreſs'd a Deſire to ſee an Experiment of it on the River *Thames*: Accordingly I ſhew'd to him, and ſeveral of the principal Officers and Commiſſioners of his Majeſty's *Navy*, the Nature and Uſe of it between *London* and *Woolwich*, when he ſeemed to be of the ſame Opinion with Dr. *Deſaguliers*, *viz.* Whether in a certain Diſtance, and in different Motions of the Veſſel, the Inſtrument could revolve equally. Hereupon he adviſed me to take a Trip over to *Holland*, and to try *my Machine* with the *Log*, in my Paſſage; as alſo throughly to examine the Truth of his Objection on the long Canals in that Country, where there was little or no Tide or Current.

Accordingly I had Orders to embark on Boardthe *William* and *Mary* Yacht, which was ordered to carry over the Lady of Count *Welderen*, one of the

then *Dutch* Ambaſſadors at our Court, to compliment his Majeſty on his Acceſſion to the Throne. My Machine being fixed at the Stern of this Veſſel, we kept her Run both by it and the *Log*. On the niceſt Calculation, in our Paſſage over, the Difference between us was 2 Miles and 2640 Feet: At this I was in no wiſe ſurpriſed; for as I knew the *Log* to be very erroneous, and I undertook to correct the Errors of it by my Inſtrument (in the Truth of which I might then be too forward, as too many are on ſuch Occaſions) I was aſſured we could not agree; and therefore I charged the Difference accordingly.

Among the conſiderable Company on board the Yacht, we had a curious Gentleman, Captain *Lynſtager*, Commander of one of the *Dutch* Men of War, who ſeemed not a little pleaſed with my Contrivance; and no ſooner did he land in *Holland*, but he ſpoke of it to ſome Gentlemen of the higheſt Rank there, whoſe Curioſity induced them to deſire to ſee an Experiment of this Invention: Accordingly I was ſent for to the *Hague*, and on the Canal there, before Baron *Hop*, Baron *Waſſenaar*, Admiral *Somelſdyk*, Mr. *s'Graveſand* (Profeſſor of the Mathematicks in the Univerſity of *Leyden*) Captain *Lynſtager*, *&c.* we run a certain Diſtance in ſwift and ſlow Motion, in order to ſee if the Inſtrument would have an equal Number of Revolutions therein. In running up, it revolv'd 2300 Times, and in coming down 2060. Here then was enough to convince me, that Dr. *Deſaguliers*, and Mr. *Molyneux*, had judged truly of the Fork, and more eſpecially ſince the learned Mr. *s'Graveſand* joined in Opinion with

them; who notwithſtanding encouraged me, by telling me my Labour was not in vain, for that the Inſtrument might ſtill be of good Service, by making Tables to rectify the different Revolutions.

An Opinion ſtrongly indulged is rarely parted with; the Truth of which I find in my ſelf; for although Dr. *Deſaguliers*, Mr. *Molyneux*, and Mr. *s'Graveſand* did jointly agree as to this Invention, yet ſtill did I entertain ſome ſlender Thoughts, that it muſt anſwer the Purpoſe, in the Manner I had propoſed. For when I conſidered, that I had two Fathom of Rope out on the *Dutch* Canal, which was but 5 or 6 Feet deep, and that the Fork of my Machine weighed about three Pounds, or three and a half, and was two Feet and a half in Length, I thought it not unreaſonable to ſuppoſe, that its Weight, in the ſloweſt Motion of the Veſſel, might occaſion it to ſtrike Ground, and conſequently impede its Motion, and leſſen the Number of Revolutions as above. Of this I had been fully ſatisfied whilſt in *Holland*; but fearing to loſe my Paſſage in the Yacht, on Board of which I had embarked by Order of the Lords Commiſſioners of the Admiralty, I was obliged to haſten over.

Not long after I came to *England* died my worthy Patron Mr. *Molyneux*, in whom all Men of Learning and Ingenuity loſt a Friend; and as there was now but little Hope of my going over to *Holland* in the Manner I had done before, I was notwithſtanding reſolved to take that Journey at my own Expence; and accordingly did ſo, where I no ſooner began my Experiments, but I was convinced of the Truth of the Objections of the three learned

learned Gentlemen afore-mentioned, which is plainly made appear from the following Figure, wherein the Poſition of the Fork, in five different Motions of the Veſſel, is repreſented. *See* Fig. 3.

This needs no Explanation, for it plainly appears, that the Pallets will be more or leſs affected by the Reſiſtance of the Water, according to the Poſition they are in; and therefore the Revolutions in a ſwift or ſlow Motion, in the ſame Diſtance, cannot be equal.

Being now fully perſuaded, that the Fork would not revolve equally in the ſame Diſtance, and in different Motions of the Veſſel, I now began to repair this Defect by calculating ſome Tables, which render it ſtill a very uſeful Inſtrument. On what Foundation I formed theſe Tables, there will be no need for me to mention, ſince I ſhall go on to ſhew what further Improvements I have made of this Inſtrument, and that it is now every Way uſeful without them. And this, I think, I cannot better do, than by entering here the Extract of a Letter to Dr. *Deſaguliers* from a learned Mathematician in *Holland*, whoſe Company I was honoured with ſeveral Times, whilſt I was making my Experiments on that Side, *viz.*

" Mr. *De Saumarez* having deſired me to acquaint
" you of the Succeſs of the Experiments, which I
" have ſeen him make of this Machine, for the meaſu-
" ring the Way of a Ship in the Sea, it is with Pleaſure
" I undertake it, ſince I am fully perſuaded you
" will not be wanting to contribute all in your Power
" to promote an Invention ſo uſeful and advantage-
" ous as this is.

" The

" The firſt Experiment that I attended was with an
" Iron Fork, ſuch as the Gentleman himſelf hath de-
" ſcribed in the *Philoſophical Tranſactions* of the
" *Royal Society*; when the Number of Revolu-
" tions were more in the ſwift than in the ſlow Mo-
" tion of the Boat, whereon we tried this Inſtru-
" ment. This I take to be owing to the different
" Inclinations of the Machine; which were more
" Horizontal, according as the Motion of the Boat
" was more ſwift; from whence we concluded, that
" it would be neceſſary to help this by ſome Ta-
" bles calculated for the Purpoſe: Since which, Mr.
" *De Saumarez* hath accordingly formed ſuch Tables;
" but as I was not preſent at the Experiments where-
" on they are founded, I leave you to the Gentle-
" man himſelf to give you an Account thereof.

" I have alſo made another Experiment with Mr.
" *De Saumarez*, upon a new Correction of his Ma-
" chine, which he will better explain to you, when
" you ſee him, than I can deſcribe. Here he has
" contrived the firſt Movement of his Machine to lie
" Horizontal under the Water; and ſuch was our
" Succeſs in this Experiment, that I make no more
" doubt of the Uſefulneſs of this Invention, which
" I look upon as very advantageous to Navigation;
" ſince the Number of Revolutions here ſcarcely
" differed 4 in 332 in the different Velocity or Mo-
" tion of the Boat: But this I muſt obſerve, that
" the Number of Revolutions here were greater
" when we moved moſt ſlow. For my Part, I do
" not queſtion, but that by a ſmall Correction, the
" Number of Revolutions may be always rendered
" proportional to the Diſtance; yet let us make no

" Hypo-

" Hypotheſes; for Experiments of this Machine,
" wherein may be had ſome Millions of its Revo-
" lutions, will perfectly ſhew the Uſe that may be
" made thereof. In the Interim I believe, that Mr. *De*
" *Saumarez*'s Invention may be, nay, ought to be,
" eſpecially with this laſt Improvement, *infinitely*
" *preferred to all other Methods for aſcertaining*
" *the Way of a Ship in the Sea*, &c.

Here then you have the Opinion of a learned Gentleman of my Improvement on this Invention, whoſe Eminence among the *Literati* is ſuch, that this alone might give a Sanction thereto. It is here obſerved, that the Difference in the Revolutions of my Machine, on this new Method, was ſcarcely 4 in 332: Who then can ſay this Difference was not owing to the different Sheers in our Boat on the Canal? But I ſhall not go about to determine this, it remains for me now only to ſhew the Improvement which I made of the *Marine Surveyor* whilſt in *Holland*, which is hinted at in the Letter above, and which is now brought to ſuch Perfection, that I perſuade my ſelf no very material Objections can be brought againſt it. The following Figure ſhews this Improvement, wherein the Objections of the different Inclinations of the Fork are now entirely removed. *See* Fig. 4.

A F G H is the Fork, in the ſame Form as the Iron Fork deſcribed in the *Philoſophical Tranſactions*, Vol. xxxiii, for the Months of *November* and *December* 1725, which differs from the other only in the Materials of which it is framed; this being contrived of ſuch as to make it equiponderous with the Water, and to lie in an Horizontal Poſition,

ſition, even though the Ship or Veſſel to which it is faſtened be at Anchor, or under Sail. H B is a Rope, of a convenient Length, fixed to a Screw or Worm at the Point B, which goes about 6 Inches into an Iron Pipe, of which B I is the Length: Through this Pipe an Iron Spindle paſſes into the aforeſaid Screw or Worm to which the Dial C is fixed; as ſoon then as the Veſſel moves, the Fork plays in an Horizontal Poſition, which moving the Spindle within the Iron Pipe, the Motion is thereby communicated to the Dial, which is fitted to ſtrike to the Miles or Leagues the Veſſel runs; and let the Veſſel move ſwift or ſlow, the Pallets A and F are equally affected, and conſequently muſt meaſure the Diſtance ſailed to a greater Exactneſs than the Iron Fork is capable of in the Manner I have deſcribed it in the *Philoſophical Tranſactions* aforeſaid. For want of better Conveniencies when in *Holland*, I had this Iron Pipe fixed to a thin Board, which I faſtened to the Rudder of the Veſſel D E; but as I am now falling on a properer Method to fix this Iron Pipe, *&c.* which I could not well do in *Holland*, ſince the cold Weather was ſo far ſet in, that it would not allow me to make more Experiments than I did on that Side, I hope ſoon to make it appear, that the Revolutions are exactly equal in this new Improvement of the Fork.

Here then do I offer what I humbly conceive cannot fail being of Service to the Community of which I am a Member, as well as to all the Maritime Powers. 'Tis the Fruit of ſeveral Years Study; for my Thoughts were firſt employed on it, when the Nation felt ſo great a Loſs as it did in the unhappy

Fate of Sir *Cloudeſly Shovel*, *&c.* ſince which Time (from the Numbers of Workmen I have employed, the various Alterations I have made, and the great Variety of Experiments carried on at my own ſole Coſt and Charges) I have been at no ſmall Expence; inſomuch that my Eſtate has felt the Weight thereof. However, it is ſome Satisfaction to me, that I have brought it to the Pitch it is now at, where I cou'd wiſh to ſee the Publick take it up, and have it tried by competent Judges againſt the *Log*, the Errors of which I have amply ſet forth in a former Diſcourſe. This, methinks, is what I might reaſonably hope for, ſince, as I ſet out with honeſt Views, in a praiſe-worthy Undertaking, I ought (to uſe the Words of a conſiderable Author on this Head) to meet with Aſſiſtance in the Beginning, with Encouragement if I ſucceed, and even with Pity, if not Praiſe, although I ſhould fail.

I am well aware, *that he who decries an old Cuſtom, ſeldom meets with Succeſs, even though what he advances againſt it may be very reaſonable.* This ſeems to be the Caſe between the *Marine Surveyor* and the *Log*; for the latter having been long in Uſe amongſt the Seamen, it may be with Difficulty the former will be received; which probably I may not live to ſee, ſince, as I am now bending beneath the Weight of Age and many Infirmities, I cannot be far off bidding Adieu to the Things of this World; and when I ſhall make my *Exit* from it, God grant ſome happy Genius may raiſe a good Structure on the Ground-work which I have here marked out: And I am the more earneſt in this Wiſh, becauſe I am firmly of Opinion,

that

that what is here advanced, if rightly conducted, cannot fail of proving highly advantageous to Trade and Navigation.

January 23d, 1728-9. *Henry de Saumarez.*

POSTSCRIPT.

In a former Diſcourſe on this Invention, and which appears in the xxxiii[d] Volume of the *Philoſophical Tranſactions*, I hinted that I was upon making a further Improvement in Navigation, whereby I propoſed to make a Ship work far better to Windward, than it is poſſible for the moſt Weatherly one to do at preſent; as alſo to make them tack and ware in much leſs Room than is generally done on ſuch Occaſions. The Advantages ariſing from ſuch a Projection, if it proves practicable, muſt be conſiderable; for

1. The Ship which is in Danger of a Lee-Shore will hereby be enabled to weather the Point ſhe may want, and not be forced, in ſtormy Weather, to anchor in the very Breach of the Shore, and even in the Jaws of Deſtruction. Of this we have had too many melancholly Inſtances, where ſeveral Lives and Fortunes have been loſt; Diſaſters of which kind, it is humbly conceived, may, in a great Meaſure, be prevented by this Invention.

2. Hence we need not fear to get the Weather-gage of an Enemy; for by plying to Windward much faſter than he can, and by tacking and waring in much leſs Compaſs, I can either leave him, or continue to engage him, as ſhall appear moſt convenient: At leaſt I can ſo ſpend the Day, as to be able to ſecure my ſelf under the Covert of the Night; or if

I chance to be near the Land, I may hereby be enabled to gain a ſafe Harbour.

3. By this Invention the wild Steerage which is too frequently made in ſome Ships, will be prevented, which all Mariners muſt allow to be of Service, eſpecially in chaſing, or being chaſed by an Enemy; as well as in their keeping the Reckoning of the Ship's Way, *&c.*

I might here touch on other Advantages ariſing from this Project, which I omit at preſent, ſince as I am about preparing ſome ſmall Models to ſhew the Nature of this Contrivance, they will fully appear therefrom: And if what I offer ſhould not be ſo practicable in large Ships, as it were to be wiſhed, I yet hope ſome happy Genius will, in Time, ſo far improve on what I ſhall hint, as to make the ſame ſerviceable to my Country.

When I conſider, that to Navigation *Great Britain* owes its Riches and Strength, it certainly ought to have the Preference to all other Arts and Sciences; and therefore any Improvement therein ſurely cannot fail of meeting with Regard; more eſpecially where ſuch deſirable Ends are propoſed, as a Method to prevent Ships being wreck'd on Lee-Shores, as alſo a Means to facilitate the Eſcape of them, when too powerfully attacked by an Enemy; or leading them to Victory, where they have any Proſpect of it, *&c.* As hereby Honour may accrue to the Nation, and the Lives and Fortunes of ſeveral People may be ſaved, I only deſire publick Experiments may be made of theſe my Machines, on the Proof of which I am willing to ſtand or fall.

H. D. S.

IV. *A ſecond Letter from Mr.* Colin Mᶜ Laurin, *Profeſſor of Mathematicks in the Univerſity of* Edinburgh *and F. R. S. to* Martin Folkes, *Eſq; concerning the Roots of Equations, with the Demonſtration of other Rules in Algebra; being the Continuation of the Letter publiſhed in the* Philoſophical Tranſactions; N° 394.

Edinburgh, April 19th, 1729.

SIR,

IN the Year 1725, I wrote to you that I had a Method of demonſtrating Sir *Iſaac Newton*'s Rule concerning the impoſſible Roots of Equations, deduced from this obvious Principle, that the Squares of the Differences of real Quantities muſt always be poſitive; and ſome time after, I ſent you the firſt Principles of that Method, which were publiſhed in the *Philoſophical Tranſactions* for the Month of *May*, 1726. The Deſign I have for ſome Time had of publiſhing a Treatiſe of Algebra, where I propoſed to treat this and ſeveral other Subjects in a new Manner, made me think it unneceſſary to ſend you the remaining Part of that Paper. But ſome Reaſons have now determined me to ſend you with the Continuation of my former Method, a ſhort Account of two other Methods in which I have treated the ſame Subject, and ſome Obſervations on Equations that I take to be new, and which will, perhaps, be more acceptable to you than what relates to the imaginary Roots themſelves. Beſides Sir *Iſaac Newton*'s Rule, there ariſes from the following general

ral Propoſitions, a great Variety of new Rules, different from his, and from any other hitherto publiſhed, for diſcovering when an Equation has imaginary Roots. I ſhall particularly explain one that is more uſeful for that Purpoſe, than any that have been hitherto publiſhed.

Suppoſe there is an Equation of (n) Dimenſions of this Form,

$$x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3} + Dx^{n-4} - Ex^{n-5} + Fx^{n-6} - Gx^{n-7} + Hx^{n-8} - Ix^{n-9} + Kx^{n-10} \&c. = 0.$$

And that the Roots of this Equation are, $a, b, c, d, e, f, g, h, i, k, l$, &c. then ſhall $A = a + b + c + d + e + f$ &c. and therefore I call a, b, c, d, e, f, &c. *Parts* or *Terms* of the Coefficient A. For the ſame Reaſon I call $ab, ac, ad, ae, bc, bd, cd$, &c. Parts or Terms of the Coefficient B; abc, abd, abe, acd, bcd, &c. Parts or Terms of C; $abcd, abce, abcf$, Parts or Terms of the Coefficient D, and ſo on. By the *Dimenſions* of any Coefficient; I mean the Number of Roots or Factors that are multiplied into each other in its Parts, which is always equal to the Number of Terms in the Equation that preceed that Coefficient. Thus A is a Coefficient of one Dimenſion, B of two, C of three, and ſo of the reſt. I call a Part or Term of a Coefficient C *ſimilar* to a Part or Term of any Coefficient G, when the Part of G involves all the Factors of the Part of C: Thus abc, $abcdefg$ are ſimilar Parts of C and G; after the ſame manner $abcd$, $abcdef$ are ſimilar Parts of D and F, the Part of F involving all the Factors of the Part of D. Thoſe I call *diſſimilar* Parts that involve no common Root or Factor: Thus abc, and $defgh$ are diſſimilar Parts of the Coefficients C and F. The Sum of all the

the Products that can be made by multiplying the Parts of any Coefficient C by all the ſimilar Parts of G, I expreſs by C′ G′ placing a ſmall Line over each Coefficient: After the ſame manner D′F′ expreſſes the Sum of all the Products that can be made by multiplying the ſimilar Parts of D and F by each other; and C′ × C′ expreſſes the Sum of the Squares of the Parts of the Coefficient C, but C′ × C, expreſſes the Sum of the Products that can be made by multiplying any two Parts of C by one another. Theſe Expreſſions being underſtood, and the five Propoſitions in *Phil. Tranſ.* N° 394, being premiſed, next follows

PROP. VI.

If the Difference of the Dimenſions of any two Coefficients C *and* G *be called* (m) *then ſhall the Product of theſe Coefficients multiplied by one another be equal to* $C'G' + \frac{}{m+2} \times B'H' + \frac{m+3}{1} \times \frac{m+4}{2} A'I' + \frac{m+4}{1} \times \frac{m+5}{2} \times \frac{m+6}{3} \times I \times K.$

Where B and H are the Coefficients adjacent to the Coefficients C and G, A and I the Coefficients adjacent to B and H, I and K the Coefficients adjacent to B and H.

It is known that $C = abc + abd + abe + abf +$ *abg*, &c. and $G = abcdefg + abcdefh + abcdefi + bcdefgh$, &c. and it is manifeſt,

1. That in the Product CG each Term of C′G′ will ariſe once as $a^2b^2c^2defg$. But

2. Any Term of B′ H′ as $a^2b^2cdefgh$ may be the Product of *abc*, and *abdefgh*, or of *abd* and *abcefgh*, or of *abe* and *abcdfgh*, or of *abf* and *abcdegh*,

$abcdegh$, or of abg and $abcdefh$, or laſtly of abh and $abcdefg$; ſo that it may be the Product of any Term of C that involves with ab one of the Roots, c,d,e,f,g,h, multiplied by that Term of G, which involves ab and the other five; that is, it may ariſe in the Product CG as often as there are Roots in $a^2b^2cdefgh$ beſides a and b, or in general, as often as there are Units in the Difference of the Dimenſions of B and H, that is, $m+2$ times; becauſe m expreſſes the Difference of the Dimenſions of C and G, and conſequently in expreſſing the Value of CG the Coefficient of the ſecond Term $B'H'$ muſt be $m+2$.

3. Any Term of AI, as $a^2bcdefghi$, may be the Product of any Part of C that involves the Root a with any two of the reſt b,c,d,e,f,g,h,i (the Number of which is the Difference of the Dimenſions of A and I, which is in general equal to $m+4$) multiplied by the Part of G that involves a and the other ſix; and therefore $a^2bcdefghi$ or any other Term of $A'I'$ muſt ariſe as often as different Products of two Quantities can be taken from Quantities whoſe Number is $m+4$, that is $\frac{\quad}{m+4} \times \frac{m+4-1}{2}$ times or $\frac{m+3}{1} \times \frac{m+4}{2}$ times; and conſequently in expreſſing the Value of CG the Coefficient of the third Term $A'I'$ muſt be $\frac{m+3}{1} \times \frac{m+4}{3}$.

4. Any Term of $1 \times K$ as $abcdefghik$, may be the Product of any Part of C that involves three of its Factors, and of the Part of G that involves the reſt, and therefore may ariſe in the Product CG as often as different

Products of three Quantities can be taken out of Quantities whose Number is $m+6$ that is, $\frac{m+6}{1} \times \frac{m+5}{2} \times \frac{m+4}{3}$ times, and therefore the Coefficient of the fourth Term in the Value of C G must be $\frac{m+4}{1} \times \frac{m+5}{2} \times \frac{m+6}{3}$.

In general, in expreſſing the Value of the Product of any two Coefficients C and G, if x expreſs the Order of any Term of this Value as $A'I'$, that is, the Number of Terms that precede it, the Coefficient of that Term muſt be $\frac{2x+m}{1} \times \frac{2x+m-1}{2} \times \frac{2x+m-2}{3}$ &c. taking as many Factors as there are Units in x.

Cor. I. If it is required to find by this Propoſition the Square of any Coefficient E, then ſuppoſe $m=0$, the Difference of the Dimenſions of the Coefficients in this Caſe vaniſhing, and we ſhall have $E^2 = E' \times E' + 2\,D'F' + 3 \times \frac{4}{2} \times C'G' + 4 \times \frac{5}{2} \times \frac{6}{3} \times B'H'$ &c. $= E' \times E' + 2\,D'F' + 6\,C'G' + 20\,B'H' + 70\,A'I' + 252\,K$. Therefore if $E' \times E_{,}$ expreſs the Sum of the Products of any two parts of E multiplied by each other, we ſhall have $E^2 = E' \times E' + 2\,E' \times E_{,}$, and therefore $E' \times E_{,} = D'F' + 3\,C'G' + 10\,B'H' + 35\,A'I' + 126\,K$.

Cor. II. It follows from this Propoſition that

$E^2 = E' \times E' + 2D'F' + 6C'G' + 20B'H' + 70A'I' + 252K.$
$DF = - - D'F' + 4C'G' + 15B'H' + 56A'I' + 210K.$
$CG = - - - - C'G' + 6B'H' + 28A'I' + 120K$
$BH = - - - - - - - - - B'H' + 8A'I' + 45K$
$AI = - - - - - - - - - - - - A'I' + 10K$
$K = - - - - - - - - - - - - - - - - - K.$

Cor. III. It eaſily appears by comparing the Theorems given in the laſt Corollary, that

$E'E' = - E^2 - 2DF + 2CG - 2BH + 2AI - 2K.$
$D'F' = - - - DF - 4CG + 9BH - 16AI + 25K$
$C'G' = - - - - - - - CG - 6BH + 20AI - 50K$
$B'H' = - - - - - - - - - BH - 8AI + 35K$
$A'I' = - - - - - - - - - - - - AI - 10K.$

PROP. VII.

Let $l = n \times \frac{n-1}{2} \times \frac{n-2}{3}$ &c. *taking as many Factors as the Coefficient* E *has Dimenſions and* $\frac{l-1}{2l} \times E^2$ *ſhall always exceed* $DF - CG + BH - AI + K$ *when the Roots of the Equation are all real Quantities.*

For it is manifeſt that l expreſſes the Number of Parts or Terms in the Coefficient E, and it is plain from Propoſition V (*See Phil. Tranſ.* N° 394) that $\frac{l-1}{2l} \times E^2$ muſt always be greater than the Sum of the Products that can be made by multiplying any two of

of the Parts of E by each other, that is, than $E' \times E_{,}$; but $2E' \times E_{,} = E^2 - E'E' =$ (by the firſt Theorem in the laſt Corollary) $2DF - 2CG + 2BH - 2A'I + 2K$, and therefore ſince $\frac{l-1}{2l} \times E^2$ muſt always exceed $E'E_{,}$, it follows that $\frac{l-1}{2l} E^2$ muſt always be greater than $DF - CG + BH - AI + K$ when the Roots of the Equation are real Quantities.

SCHOL. In following my Method this was the firſt general Propoſition preſented it ſelf. For having firſt obſerved that if l expreſſes the Number of any Quantities, the Square of their Sum multiplied by $\frac{l-1}{2l}$ muſt always exceed the Sum of the Products made by multiplying any two of them by each other; and that the Exceſs was the Sum of the Squares of the Differences of the Quantities divided by $2l$, it was eaſy to ſee in the Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3} + Dx^{n-4}$ &c. $= 0$. Since B is the Sum of the Products of any two of the Parts of A, that if l expreſſes the Number of the Roots of the Equation, $\frac{l-1}{2l} \times A^2$ muſt always exceed B; and this is one Part of the 5th Propoſition. In the next Place, I compared the Sum of the Products of any two Parts of B with AC, and found that it was not equal to AC but to AC — D from which I inferred, that if l expreſſes

 the

the Number of the Parts of B then $\frac{l - r}{2l} \times B^r$ muſt always exceed AC — D; and theſe eaſily ſuggeſted this general Propoſition.

PROP. VIII.

Let r *expreſs the Dimenſions of the Coefficient* C, *and* s *the Difference of the Dimenſions of the Coefficients* C *and* G, *then* B *and* H *being Coefficients adjacent to* C *and* G, $\overline{n - r - s} \times r$ C′ G′ *ſhall always be greater than* $\overline{s + 1} \times \overline{s + 2} \times$ B′H′ *when the Roots of the Equation are all real Quantities affected with the ſame Sign.*

For taking the Differences of all thoſe Parts of the Coefficient C that are ſimilar in all their Factors but one, as *abc*, *abb*, *abi*, &c. and multiplying the Square of each Difference by ſuch Parts of the Coefficient D (which is of *s* Dimenſions) as are diſſimilar to both the Parts of C in that Difference, the Sum of all thoſe Squares thus multiplied, will conſiſt of Terms of C′G′ taken poſitively, and of Terms of B′H′ taken negatively. By multiplying in this manner $\overline{abc - abb}|^2 + \overline{abc - abi}|^2 + \overline{abc - abk}|^2$ &c. $+ \overline{abc - acb}|^2 + \overline{abc - aci}|^2 + \overline{abc - ack}|^2$ &c. $+ \overline{abc - bcb}|^2 + \overline{abc - bce}|^2 + \overline{abc - bck}|^2$ &c. by *defg* the Term of D, that is diſſimilar to all thoſe Parts of C, you will find that $a^2b^2c^2defg$ will ariſe in the Sum of the Products $r \times \overline{n - r - s}$ times: For thoſe Products may be alſo expreſſed thus $defga^2b^2 \times \overline{\overline{c - b}|^2 + \overline{c - i}|^2 + \overline{c - k}|^2}$ &c. $+ defga^2c^2 \times \overline{\overline{b - b}|^2 + \overline{b - i}|^2 + \overline{b - k}|^2}$ &c. $+ defgb^2c^2$.

$\overline{defgb^2c^2} \times \overline{a-b}|^2 + \overline{a-i}|^2 + \overline{a-k}|^2$ &c. where the Number of the Differences $c-b$, $c-i$, $c-k$, &c. whoſe Squares are multiplied by $defga^2b^2$ is manifeſtly equal to the Number of the Roots of the Equation that do not enter $a^2b^2c^2defg$ or $abcdefg$, that is, to the Exceſs of the Number of the Roots of the Equation above the Dimenſions of $abcdefg$, a Term of G, that is to $\overline{n-r-s}$. But in collecting all the ſaid Products, $\overline{n-r-s} \times a^2b^2c^2defg$ muſt ariſe as often as there are Units in r: Becauſe the Terms which are ſubtracted from abc may differ from it in the Root c, as abh, abi, abk, &c. or in the Root b, as ach, aci, ack, &c. or in the Root a as bch, bci, bck; that is, $\overline{n-r-s} \times a^2b^2c^2defg$ muſt ariſe as often as there are Dimenſions in abc, a Term of C, or as often in general as there are units in r, which expreſſes the Dimenſions of C: Therefore the Term $a^2b^2c^2defg$ will ariſe in the Sum of the above-mentioned Products $r \times \overline{n-r-s}$ times.

The Negative Part muſt conſiſt of the Terms of B′H′ doubled; each of which, as $2a^2b^2cdefg$ may ariſe as often as there can be Differences $c-d$, $c-e$, $c-f$, $c-g$, $d-e$, &c. aſſumed amongſt the Terms c,d,e,f,g whoſe Number is equal to $s+2$ that is, $\overline{s+2} \times \frac{s+1}{2}$ times; and therefore a^2b^2cdefg or any other Part of B′H′ muſt ariſe in the negative Part $\overline{s+1} \times \overline{s+2}$ times; and ſince the whole aggregate muſt be poſitive it follows $\overline{n-r-s} \times r.C'G'$ muſt always exceed $\overline{s+1} \times \overline{s+2} \times B'H'$.

Cor.

Cor. I. Suppoſe we are to compare E′E′ the Sum of the Squares of the Parts of E with D′F′ the Sum of the Products of the ſimilar Parts of D and F; in this Caſe s vaniſhes, and therefore $\overline{n-r} \times r$ E′E′ muſt exceed 2 D′F′. Let $\overline{n-r} \times r = m$ and conſequently $\overline{n-r-1} \times \overline{r-1} = m-n+1$; $\overline{n-r-2} \times \overline{r-2} = m-2n+4$; $\overline{n-r-3} \times \overline{r-3} = m-3n+9$; $\overline{n-r-4} \times \overline{r-4} = m-4n+16$. Since it is plain that $\overline{n-r-q} \times \overline{r-q} = \overline{n-r} \times r - qn + q^2$. Then by this Propoſition, ſuppoſing

$$m \times E'E' - 2D'F' = a'$$
$$\overline{m-n+1} \times D'F' - 12C'G' = b'$$
$$\overline{m-2n+4} \times C'G' - 30B'H' = c'$$
$$\overline{m-3n+9} \times B'H' - 56A'I' = d'$$
$$\overline{m-4n+16} \times A'I' - 90K' = e'$$

The Quantities a', b', c', d', e', muſt be always poſitive when the Roots of the Equation are real Quantities affected with the ſame Sign. The Coefficients prefixed to the negative Parts are the Numbers 2,12,30,56,90, whoſe Differences equally increaſe by the ſame Number 8.

Cor. II. Suppoſing as before, that $\overline{n-r} \times r = m$; and alſo that $m \times \overline{m-n+1} = m'$; $m' \times \overline{m-2n+4} = m''$; $m'' \times \overline{m-3n+9} = m'''$ &c. it may be demonſtrated after the manner of this Propoſition, that if

$$mE'E' - 2D'F' = a'$$
$$m'E'E' - 2 \times 12C'G' = a''.$$
$$m''E'E' - 2 \times 12 \times 30B'H' = a'''$$
$$m'''E'E' - 2 \times 12 \times 30 \times 56A'I' = a'''' \text{ &c.}$$

Then

Then ſhall a',a'',a''', &c. be always poſitive when the Roots are real Quantities, whether they be affected with the ſame, or with different Signs. The Negative Coefficients ariſe by multiplying thoſe in the preceeding Corollary, 2,12,30,56,90, by one another.

PROP. IX.

Let a',b',c',d',e', *and* m *expreſs the ſame Quantities as in the Corollaries of the laſt Propoſition, and* $m\,E^2 - \overline{m+n+1} \times DF = a' + b' + 2c' + 5d' + 14e'$.

For by Cor. ii Prop. vi.

$E^2 = E'E' + 2D'F' + 6C'G' + 20B'H' + 70A'I' + 252K$,

and by the ſame

$DF = \text{- - -} D'F' + 4C'G' + 15B'H' + 56A'I' + 210K$;

therefore $m\,E^2 - \overline{m+n+1} \times DF = m.E'E' + \overline{m-n-1} \times D'F' + \overline{m-2n-2} \times 2C'G' + \overline{m-3n-3} \times 5B'H' + \overline{m-4n-4} \times 14A'I' + \overline{m-5n-5} \times 42K =$ (by ſubſtituting ſucceſſively for $m\,E'E'$, $\overline{m-n+1} \times D'F'$, $\overline{m-2n+4} \times C'G'$, $\overline{m-3n+9} \times B'H'$, $\overline{m-4n+16} \times A'I'$ their Values deduced from the firſt Corollary of the laſt Propoſition) $= a' + b' + 2c' + 5d' + 14e'$, where the Coefficients prefixed to a',b',c',d',e', are the Differences of the Coefficients of $E'E'$, $D'F'$, $C'G'$, $B'H'$, $A'I'$ and K in the Values of E^2 and DF taken from Cor. ii. Prop. vi. being 1 — 0, 2 — 1, 6 — 4, 20 — 15, 70 — 56 and 252 — 210.

Cor. Since $m = \overline{n-r} \times r$ therefore $m + n + 1 = \overline{n-r+1} \times \overline{r+1}$; and consequently $\frac{r}{r+1} \times \frac{n-r}{n-r+1} \times E^{\overline{n}}$ must always be greater than D F the Product of the Coefficients adjacent to E; and hence the Fractions are deduced, that in Sir *Isaac Newton*'s Rule are placed over the Terms of the Equation, which multiplied by the Square of the Terms under them, must always exceed the Products of the adjacent Terms of the Equation, when the Roots are real Quantities: For it is manifest that the Fraction to be placed over the Term Ex^{n-r} according to that Rule is the Quotient of $\frac{n-r}{r+1}$ divided by $\frac{n-r+1}{r}$.

PROP. X.

The same Expressions being allowed as in the preceeding Propositions, it will be found in the same manner that as $mE^{\overline{2}} - \overline{m+n+1} \times DF = a' + b' + 2c' + 5d' + 14e'$ so

$\overline{m-n+1} \times DF - \overline{m+2n+4} \times CG = - b' + 3c' + 9d' + 28e'$

$\overline{m-2n+4} \times CG - \overline{m+3n+9} \times BH = - - c' + 5d' + 20e'$

$\overline{m-3n+9} \times BH - \overline{m+4n+16} \times AI = - - - - d' + 7e'$

$\overline{m-4n+16} \times AI - \overline{m+5n+25} \times K = - - - - - - - e'$.

These Theorems are easily deduced from the Theorems given in the second Corollary of Prop. vi. and the first Corollary of the viii^th^ Proposition; and the Coefficients prefixed to a', b', c', d', e', are the Differences of the Coefficients of the corresponding Terms in the Values of $E^{\overline{2}}$, D F, C G, B H, A I and K in Cor. ii. Prop. vi.

Cor. Hence the Products of any two Coefficients, as D F and A I may be compared together when the Sum of the Dimensions of D and F is equal to the Sum of the Dimensions of A and I. Let the Dimensions of A and F be equal to s and m respectively, and let $p = \frac{n-s}{s+1} \times \frac{n-s-1}{s+2} \times \frac{n-s-2}{s+3}$ &c. taking as many Factors as there are Units in the Difference of the Dimensions of D and A. Let $q = \frac{n-m}{m+1} \times \frac{n-m-1}{m+2} \times \frac{n-m-2}{m+3}$ &c. taking as many Factors as you took in the Value of p. Then shall $\frac{q}{p} \times$ D F always exceed A I when the Roots of the Equation are real Quantities affected with the same Sign; and this Rule obtains, though the Roots are affected with different Signs when the Coefficients D and F are equal.

PROP. XI.

The same Things being supposed as in the preceeding Propositions.

1. $mE^2 - \overline{m+1} \times 2DF + \overline{m+4} \times 2CG - \overline{m+9} \times 2BH + \overline{m+16} \times 2AI - \overline{m+25} \times 2K$ - - $\} = a'$.

2. $\overline{m-n+1} \times DF - \overline{m-n+4} \times 4CG + \overline{m-n+9} \times 9BH - \overline{m-n+16} \times 16AI + \overline{m-n+25} \times 25K \} = b'$.

3. $\overline{m-2n+4} \times CG - \overline{m-2n+9} \times 6BH + \overline{m-2n+16} \times 20AI + \overline{m-2n+25} \times 50K$ - - - - - - $\} = c'$.

4. $\overline{m-3n+9} \times BH - \overline{m-3n+16} \times 8AI + \overline{m-3n+25} \times 35K = d'$.

5. - - $\overline{m-4n+16} \times AI - \overline{m-4n+25} \times 10K = e'$.

Theſe Theorems follow eaſily from the third Corollary of the vi^th Propoſition. The firſt eaſily appears thus, $a' = m E' E' - 2 D' F' =$ (by that Corollary)

$$m E^2 - 2 m DF + 2 m CG - 2 m BH + 2 m AI - 2 m K.$$
$$- 2 DF + 8 CG - 18 BH + 32 AI - 50 K.$$

$$= m E^2 - \overline{m+1} \times 2 DF + \overline{m+4} \times 2 CG - \overline{m+9} \times 2 BH + \overline{m+16} \times 2 AI - \overline{m+25} \times 2 K.$$

The other Theorems are deduced from the ſame Corollary compared with Cor. i. Prop. viii.

PROP. XII.

The ſame Things being ſuppoſed as in the ſecond Corollary of the viii^th *Propoſition.*

1. $m E^2 - \overline{m+1} \times 2 DF + \overline{m+4} \times 2 CG - \overline{m+9} \times 2 BH + \overline{m+16} \times 2 AI - \overline{m+25} \times 2 K$ - - - $= a'.$

2. $m' E^2 - 2 m' DF + \overline{m'-12} \times 2 CG - \overline{m'-72} \times 2 BH + \overline{m'-240} \times 2 AI - \overline{m'-600} \times 2 K$ - - - $= a''.$

3. $m'' E^2 - 2 m'' DF + 2 m'' CG - \overline{m''+360} \times 2 BH + \overline{m''+360 \times 8} \times 2 AI - \overline{m''+360 \times 35} \times 2 K = a'''.$

4. $m'''' \times \overline{E^2 - 2 DF + 2 CG - 2 BH + \overline{m''-750 \times 28} \times AI - \overline{m''''-7200 \times 28} \times 2 K}$ - - - - - - - - $= a''''.$

&c.

Theſe Theorems follow from the third Corollary of the vi^th Propoſition compared with the ſecond Corollary of the eighth Propoſition. The firſt is the ſame with the firſt of the laſt Propoſition. The ſecond is demonſtrated by ſubſtituting in $m' E' E' - 24 C' G' = a''$. The Values of $E' E'$ and $C' G'$ given in the third

Cor. of the vith Propoſition. The third is found by ſubſtituting in $m''' E'E' - 720 B'H' = a'''$ the Values of $E'E'$ and $B'H'$; and by a like Subſtitution theſe Theorems may be continued.

A General COROLLARY.

From theſe Propoſitions a great Variety of Rules may be deduced for diſcovering when an Equation has imaginary Roots. The Foundation of Sir *Iſaac Newton*'s Rule is demonſtrated in the ninth Propoſition, and its Corollary. The ſeventh Propoſition ſhews that if $\frac{l-1}{2l} \times E^2$ does not exceed $DF - CG + BH - AI + K$, ſome of the Roots of the Equation muſt be imaginary; and ſometimes this Rule will diſcover impoſſible Roots in an Equation, that do not appear by Sir *Iſaac Newton*'s Rule. Theſe are the only two Rules that have been hitherto publiſhed. But the Rules that ariſe from the Theorems in the eleventh and twelfth Propoſitions, are preferable to both; becauſe any imaginary Roots that can be diſcovered by the viith or ixth always appear from the xith and xiith Propoſitions; and impoſſible Roots will often be diſcovered by the xith and xiith Propoſitions in an Equation, that do not appear in that Equation when examined by the viith and ixth Propoſitions. The Advantage which the Rules deduced from the xith Propoſition, have above thoſe deduced from the preceeding Propoſitions, will be manifeſt by conſidering that in the xith Propoſition we have the Values of the Quantities a', b', c', d', e', ſeparately; whereas in the preceeding Propoſitions, we have only the Values of certain Aggregates of theſe Quantities

joined with the ſame Signs. Now it is obvious that if theſe Quantities be ſeparately found poſitive, any ſuch Aggregates of them muſt be poſitive; but theſe Aggregates may be poſitive, and yet ſome of the Quantities a', b', c', d', e', themſelves may be found negative: From which it follows, that if the Roots of the Equation are all affected with the ſame Sign, and no impoſſible Roots appear by Propoſition xith, none will appear by the preceeding Propoſitions; but that ſome imaginary Roots may be diſcovered by Propoſition xith, when none appear in the Equation examined by the Propoſitions that preceed the xith. If ſome of the Roots of the Equation are poſitive, and ſome negative (which always eaſily appears by conſidering the Signs of the Terms of the Equation) then the xiith Propoſition will be in many Caſes more apt to diſcover imaginary Roots in an Equation than thoſe that preceed it.

The Rule that flows from the firſt Theorem of the xith Propoſition, obtains when the Roots of the Equation are affected with different Signs, as well as when they all have the ſame Sign, and it is this; Multiply the Number of the Terms in an Equation that preceeds any Term, as $E x^{"-'}$ by the Number of Terms that follow it in the ſame Equation, and call the Product m. Suppoſe that $+D, -C, +B, -A, +I$ are the Coefficients preceeding the Term $E x^{"-'}$, and that $+F$, $-G, +H, -I, +K$ are the Coefficients that follow it; then if $\frac{1}{2} m E^2$ does not exceed $\overline{m+1} \times DF - \overline{m+4} \times CG + \overline{m+9} \times BH - \overline{m+16} \times AI + \overline{m+25} \times K$ the Equation muſt have ſome imaginary Roots; where the Coefficients $m+1, m+4, m+9,$ &c.

&c. are found by adding to m the Squares of the Numbers 1, 2, 3, 4, &c. which ſhew the Diſtances of the Coefficients to which they are prefixed, from the Coefficient E. The ſecond Theorem of the xiith Propoſition ſhews, that if $\frac{1}{2} m' E^2$ does not exceed $m' DF - \overline{m' - 12} \times CG + \overline{m - 72} \times BH - \overline{m' - 240} \times AI + \overline{m' - 600} \times K$, the Equation muſt have ſome Roots imaginary.

For an Example, If the four Roots of the Biquadratick Equation $x^4 - Ax^3 + Bx^2 - Cx + D = 0$ are real Quantities, it will follow equally from the vth, viith, ixth, and xith Propoſitions, that $\frac{3}{8} A^2$ muſt be greater than B, and that $\frac{3}{8} C^2$ muſt exceed B D. The viith further ſhews that $\frac{5}{12} B^2$ muſt exceed $AC - D$; the ixth demonſtrates that $\frac{4}{9} B^2$ muſt exceed A C; but our Rule deduced from Prop xi. ſhews that $2 B^2$ muſt exceed $5 AC - 8 D$, the exceſs being $\frac{1}{2} a'$, and the Rule deduced from the ſecond Theorem of the xiith Propoſition ſhews that B^2 muſt always exceed $2 AC + 4 D$, the Exceſs being $\frac{1}{4} a''$. It appears from ſeveral preceeding Propoſitions, that if the Roots of the Equation have all the ſame Sign, then AC muſt exceed 16 D: Let the Exceſſes $5 B^2 - 12 AC + 12 D = p$, $4 B^2 - 9 AC = q$, $AC - 16 D = s$; and it is plain that $a' (= 4 B^2 - 10 AC + 16 D) = q - s$

$-s = \frac{2}{5} \times \overline{2p - s}$; and that $a'' = q + s = \frac{2}{5} \times \overline{2p + 4s}$. Let us ſuppoſe,

1. That s is poſitive, then it is manifeſt that if either p or q be negative, a' muſt alſo be found negative, and conſequently that when the viith or ixth Propoſitions ſhew any Roots to be imaginary, the xith Propoſition muſt diſcover them at the ſame time. But as a' $(= q - s = \frac{2}{5} \times \overline{2p - s})$ may be found negative when p and q are both poſitive, it follows that the Rule we have deduced from the xith Propoſition may diſcover imaginary Roots in an Equation, that do not appear by the preceeding Propoſitions: Thus if you examine the Equation $x^4 - 6x^3 + 10x^2 - 7x + 1$ by Sir *Iſaac Newton*'s Rule, or by our viith Propoſition, no imaginary Roots appear in it from either. But ſince $2B^2 - 5AC + 8D (= \frac{1}{2}a') =$ $200 - 210 + 8 = -2$ is in this Equation negative, it is manifeſt that two Roots of the Equation muſt be imaginary. Let us ſuppoſe

2 That s is negative, and that from the Signs of the Terms of the Equation, it appears that ſome Roots are poſitive and ſome negative; then in Order to ſee if the Equation has any imaginary Roots, the moſt uſeful Rule is that we deduced from the ſecond Theorem of Prop. xii. *viz.* that if B^2 does not exceed $2AC + 4D$ ſome of the Roots of the Equation muſt be imaginary: For the Exceſs of B^2 above $2AC + 4D$ being $\frac{1}{4}a'' = \frac{1}{4} \times \overline{q + s} = \frac{1}{10} \times \overline{2p + 4s}$, and s

being

being negative, it is manifeſt, that if q or p be negative $\frac{1}{4}a''$ muſt be negative; and that $\frac{1}{4}a''$ may be negative when q and p are both poſitive; that is, This Rule muſt always diſcover ſome Roots to be imaginary when the viith or ixth Propoſitions diſcover any impoſſible Roots in an Equation; and will very often diſcover ſuch Roots in an Equation when theſe Propoſitions diſcover none. For Example, if you examine the Equation $x^4 + 5x^3 + 6x^2 - x - 12 = 0$, you will diſcover no imaginary Roots in it by the viith or ixth Propoſitions; and though $AC - 16D\ (= s)$ be negative, it does not follow, that the Equation has any impoſſible Roots, becauſe it appears from the Signs of the Terms, that the Equation has Roots affected with different Signs. But ſince $B^2 - 2AC - 4D\ (= 36 + 10 - 48 = -2)$ is negative, it appears from our Rule, that the Equation muſt have ſome imaginary Roots.

I might ſhew in the next Place, how the Rules deduced from the xith and xiith Propoſitions may be extended ſo as to diſcover when more than two Roots of an Equation are imaginary, and in general to determine the Number of imaginary Roots in any Equation; but as it would require a long Diſcuſſion, and ſome *Lemmata* to demonſtrate this ſtrictly, I ſhall only obſerve that theſe xith and xiith Propoſitions will be found to be ſtill the moſt uſeful of all thoſe we have given for that Purpoſe. To give one Example of this; If we are to examine the Equation $x^4 - 4ax^3 + 6a^2x^2 - 4ab^2x + b^4 = 0$ by Sir *Iſaac Newton*'s Rule, it is found

(+ — + — +)

to have four impoſſible Roots when a is greater than b; for though the Square of the ſecond Term multiplied

ed by $\frac{3}{8}$ be equal to the Product of the firſt and third Terms, yet in that Caſe, in applying Sir *Iſaac Newton*'s Rule, the Sign — ought to be placed under the ſecond Term, and the ſame is to be ſaid of the Square of the fourth Term. The Rule deduced from the vii^th^ Propoſition ſhews four Roots imaginary, when a is greater than b, and alſo when b^2 is greater than $15\ a^2$; but a Rule founded on the xi^th^ Propoſition, ſhews the four Roots to be imaginary always when a exceeds b, or when b^2 exceeds $9\ a^2$; from which the Excellency of this Rule above theſe two is manifeſt. I have ſaid ſo much of Biquadratick Equations, that I muſt leave it to thoſe that are willing to take the Trouble, to make like Remarks on the higher Sorts of Equations.

In inveſtigating the preceeding Propoſitions, when I found my ſelf obliged to go through ſo intricate Calculations, I often attempted to find ſome more eaſy Way of treating this Subject. The following was of conſiderable Uſe to me, and may perhaps be entertaining to you. By it, I inveſtigate ſome *maxima* in a very eaſy Manner, that could not be demonſtrated in the common Way with ſo little Trouble.

LEMMA V. Let the given Line AB be divided any where in P and the Rectangle of the Parts AP and PB will be a *maximum* when theſe Parts are equal.



This is manifeſt from the Elements of *Euclid*.

LEMMA VI. If the Line AB is divided into any Number of Parts AB, CD, DE, EB, the Product of all thoſe Parts multiplied into one another will be a *max-*

maximum when the Parts are equal amongſt themſelves. For let the Point D be where you will, it is manifeſt that if DB be biſſected in E, the Product AC × CD × DE × EB will be greater than AC × CD × D*e* × *e*B.

A C D E *e* B

becauſe by the laſt Lemma DE × EB is greater than D*e* × *e*B; and for the ſame reaſon AD and CE muſt be biſſected in C and D; and conſequently all the Parts AC, CD, DE, EB muſt be equal amongſt themſelves, that their Product may be a *maximum*.

LEMMA VII. The Sum of the Products that can be made by multiplying any two Parts of AB by one another is a *maximum* when the Parts are equal. The Sum of theſe Products is AC × CB + CD × DB + DE × EB: Now that DE × EB may be a *maximum*, DB muſt be biſſected in E by the vth Lemma, and for the ſame reaſon AD and CE muſt be biſſected in C and D, that is all the Parts, AC, CD, DE, EB muſt be equal, that the Sum of all theſe Products may be a *maximum*.

LEMMA VIII. The Sum of the Products of any three Parts of the Line AB is a *maximum*, when all the Parts are equal. For that Sum is AC × CD × DE + EB × AC × CD + AC × DE + CD × DE; and ſuppoſing the Point E given, it is manifeſt that AE muſt be equally triſected in C and D that AC × CD × DE may be a *maximum* by Lemma vi. and that AC × CD + AC × DE + CD × DE may be a *maximum* by Lemma vii^th^. From which it is manifeſt that all the Parts AC, CD, DE, EB muſt be equal, that the Sum of the Products of any three of them may be a *maximum*.

LEMMA IX. It is manifeſt that this way of reaſoning is general, and that the Sum of any Quantities being given, the Sum of all the Products that can be

made by multiplying any given Number of them by one another, muſt be a *maximum* when theſe Quantities are equal. But the Sum of the Squares, or of any pure Powers of theſe Quantities, is a *minimum*, when the Quantities are equal.

THEOREM.

Suppoſe $x^n - A x^{n-1} + B x^{n-2} - C x^{n-3} + D x^{n-4} - E x^{n-5}$ &c. $= 0$, *to be an Equation that has not all its Roots equal to one another: Let* r *expreſs the Dimenſions of any Coefficient* D, *and let* $l = n \times \frac{n-1}{2} \times \frac{n-2}{3} \times \frac{n-3}{4}$ &c. *taking as many Factors as there are Units in* r; *then ſhall* $\frac{l}{n^r} \times A^r$ *be always greater than* D, *if the Roots of the Equation are real Quantities affected with the ſame Sign.*

This may be demonſtrated from the preceeding Propoſitions: But to demonſtrate it from the laſt Lemmata, let us aſſume an Equation that has all its Roots equal to one another, and the Sum of all its Roots equal to A, the Sum of the Roots of the propoſed Equation. This Equation will be $\overline{x - \frac{1}{n} A}\Big|^n = 0$, or

$$x^n - A x^{n-1} + n \times \frac{n-1}{2} \times \frac{A^2}{n^2} x^{n-2} - n \times \frac{n-1}{2} \times \frac{n-2}{3} \times \frac{A^3}{n^3} x^{n-3} \text{ &c.} = 0$$

and if r expreſs the Dimenſions of the Coefficient of any Term of this Equation (or the Number of Terms which pre-

preceed it) it is manifeſt that the Term it ſelf will be $l \times \frac{A^r}{n^r} x^{n-r}$: But by the Suppoſition D x^{n-r} is the Correſponding Term in the propoſed Equation, and D muſt be the Sum of all the Products that can be made by multiplying as many Roots of that Equation by one another, as there are Units in r; and $\frac{l\,A^r}{n^r}$ muſt be the Sum of the like Products of the Roots of the other Equation; which muſt be the greater Quantity by the preceeding Lemmata, becauſe its Roots are equal amongſt themſelves, and their Sum is equal to the Sum of the Roots of the propoſed Equation; and the Sum of ſuch Products is a *maximum* when the Roots are equal amongſt themſelves. By purſuing this Method, it may be demonſtrated that $\left|\frac{2B}{n \times n-1}\right|^{\frac{r}{2}} \times l$ muſt always exceed the Coefficient prefixed to the Term x^{n-r} in an Equation whoſe Roots are all real Quantities affected with the ſame Sign; providing that r be a Number greater than 2; and alſo that $\left|\frac{2 \times 3C}{n \times n-1 \times n-2}\right|^{\frac{r}{3}} \times l$ muſt exceed the ſame Coefficient, if r be any Number greater than 3.

It is eaſy to continue theſe Theorems.

The third Method which I mentioned in the Beginning of this Letter, is deduced from the Conſideration of the Limits of the Roots of Equations; and though it is explained by ſome Authors already, yet as I de-

monſtrate and apply it to this Subject in a different Manner, I ſhall add a ſhort Account of it.

LEMMA X. If you transform the Biquadratick $x^4 - Ax^3 + Bx^2 - Cx + D = 0$ into one that ſhall have each of its Roots leſs than the reſpective Values of x by a given Difference e; ſuppoſe $y = x - e$ or $x = e + y$ and the transformed Equation, the Order of the Terms being inverted, will have this Form.

$$\begin{array}{l} e^4 + 4e^3y + 6e^2y^2 + 4ey^3 + y^4 = 0. \\ -Ae^3 - 3Ae^2y - 3Aey^2 - Ay^3 \\ +Be^2 + 2Bey + By^2 \\ -Ce - Cy \\ +D \end{array}$$

Where it is manifeſt,

1. That the firſt Term $e^4 - Ae^3 + Be^2 - Ce + D$ is the Quantity that ariſes by ſubſtituting e in Place of x in the propoſed Equation $x^4 - Ax^3 + Bx^2 - Cx + D$.

2. That the Coefficient of the ſecond Term $4e^3 - 3Ae^2 + 2Be - C$ is the Quantity that ariſes by multiplying each Part of the firſt $e^4 - Ae^3 + Be^2 - Ce + D$ by the Index of e in that Part, and dividing the Product by e.

3. That the Coefficient of the third Term $6e^2 - 3Ae + B$ is the Quantity that ariſes from the preceeding Coefficient $4e^3 - 3Ae^2 + 2Be - C$ by multiplying each Part by the Index of e in it, and dividing the Product by $2e$.

4. That the Coefficient of the fourth Term ariſes in like Manner from the preceeding, only you now divide by $3e$; and in general, the Coefficient of any Term may be deduced from the Coefficient of that Term which preceeds it, by multiplying each Part of

the preceeding Coefficient by the Index of e in that Part, and dividing the Product by e and by the Index of y, in the Term whoſe Coefficient is required.

LEMMA XI. If any Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. $= 0$ be transformed in the ſame Manner, by ſuppoſing $x = y - e$ or $x = e + y$, and conſequently $x^n = \overline{e+y}|^n$, $Ax^{n-1} = A \times \overline{e+y}|^{n-1}$, $Bx^{n-2} = B \times \overline{e+y}|^{n-2}$ &c. The transformed Equation will have this Form, the Order of the Terms being inverted,

$$e^n + ne^{n-1}y + n \times \frac{n-1}{2} \times e^{n-2}y^2 \text{ &c.} = 0$$

$$-Ae^{n-1} - \overline{n-1} \times Ae^{n-2}y - \overline{n-1} \times \frac{n-2}{2} \times Ae^{n-3}y^2 \text{ &c.}$$

$$+Be^{n-2} + \overline{n-2} \times Be^{n-3}y + \overline{n-2} \times \frac{n-3}{2} \times Be^{n-4}y^2 \text{ &c.}$$

$$-Ce^{n-3} - \overline{n-3} \times Ce^{n-4}y - \overline{n-3} \times \frac{n-4}{2} \times Ce^{n-5}y^2 \text{ &c.}$$

&c. &c. &c.

Where it is manifeſt,

1. That the firſt Term $e^n - Ae^{n-1} + Be^{n-2} - Ce^{n-3}$ &c. is the Quantity that ariſes by ſubſtituting e in the Place of x in the propoſed Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c.

2. That the Coefficient of the ſecond Term $ne^{n-1} - \overline{n-1} \times Ae^{n-2} + \overline{n-2} \times Be^{n-3} - \overline{n-3} \times Ce^{n-4}$ &c. is deduced from the preceeding $e^n - Ae^{n-1} + Be^{n-2} - Ce^{n-3}$ &c. by multiplying each of its Parts by the Index of e in that Part, and dividing by e.

3. That

3. That the Coefficient of the third Term is deduced from the Coefficient of the ſecond Term, by multiplying after the ſame manner, each of its Parts by the Index of e and dividing by $2e$. In general, the Coefficient of any Term y^r is deduced from the Coefficient of the preceeding Term, that is of y^{r-1} by multiplying every Part of that Coefficient by the Index of e in it, and dividing the Product by re.

LEMMA XII. If you ſubſtitute any two Quantities K and L in the Place of x in $x^4 - Ax^3 + Bx^2 - Cx + D$, and the Quantities that reſult from theſe Subſtitutions be affected with contrary Signs, the Quantities K and L muſt be *Limits* of one or more real Roots of the Equation $x^4 - Ax^3 + Bx^2 - Cx + D = 0$. That is, one of theſe Quantities muſt be greater, and the other leſs than one or more Roots of that Equation.

For if you ſuppoſe that a, b, c, d, are the Roots of that Equation, then it is plain from the *Geneſis* of Equations, that $x^4 - Ax^3 + Bx^2 - Cx + D = \overline{x-a} \times \overline{x-b} \times \overline{x-c} \times \overline{x-d}$; and therefore K and L being ſubſtituted for x in $\overline{x-a} \times \overline{x-b} \times \overline{x-c} \times \overline{x-d}$, the Product becomes in the one Caſe poſitive, and in the other negative; ſo that one of the Factors $x-a, x-b, x-c, x-d$ muſt have a Sign when K is ſubſtituted for x in it, contrary to the Sign which it is affected with when L is ſubſtituted in in it for x, ſuppoſe that Factor to be $x-b$; and ſince K $-b$ and L $-b$ are Quantities whereof the one is poſitive, and the other negative, it is manifeſt that b one of the Roots of the Equation muſt be leſs than one, and greater than the other of the two Quan-

tities K and L : So that K and L muſt be the *Limits* of the Root b.

I ſay further, that the Root whereof K and L are *Limits*, muſt be a real Root of the Equation ; for the Product of the Factors that involve impoſſible Roots in an Equation can never have its Signs changed by ſubſtituting any real Quantity whatſoever in place of x; becauſe the Number of ſuch Roots is always an even Number, and the Product of any two of theſe Roots ſuch as $x - m - \sqrt{-n}$, and $x - m + \sqrt{-n}$ is $\overline{x - m}|^2 + n^2$ which muſt be always poſitive, whatever Quantity be ſubſtituted for x while n remains poſitive, that is, while theſe two Roots are impoſſible.

LEMMA XIII. If you ſubſtitute K and L for x in $x^n - A x^{n-1} + B x^{n-2}$ &c. and the Quantities that reſult be affected with contrary Signs, then ſhall K and L be the *Limits* of one or more real Roots of the Equation $x^n - A x^{n-1} + B x^{n-2}$ &c. $= 0$. This may be demonſtrated after the ſame Manner as the laſt Lemma.

THEOREM I. If a, b, c, d are the Roots of the Equation $x^4 - A x^3 + B x^2 - C x + D = 0$, they ſhall be the *Limits* of the Roots of the Equation $4x^3 - 3Ax^2 + 2Bx - C = 0$.

Suppoſe a to be the leaſt Root of the biquadratick $x^4 - A x^3 + B x^2 - C x + D = 0$, b the ſecond Root, c the third, and d the fourth, and the Values of y in the Equation in the xth Lemma, will be $a - e$, $b - e$, $c - e$, $d - e$; then by ſubſtituting ſucceſſively a, b, c, d for e in that Equation of y, one of the Values of y will vaniſh in every Subſtitution, and the firſt Term of the Equation of y, *viz.* $e^4 - Ae^3 + Be^2 - Ce + D$ vaniſhing, the Equation will be reduced to a Cubick of this Form.

4 e

$$\begin{array}{l} 4e^3 + 6e^2y + 4ey^2 + y^3 = 0 \\ -3Ae^2 - 3Aey - Ay^2 \\ +2Be + By \\ -C \end{array}$$

And consequently $4e^3 - 3Ae^2 + 2Be - C$ must be the Product of the three remaining Values of y having its Sign changed; that is, it must be equal to $-\overline{b-a} \times \overline{c-a} \times \overline{d-a}$ when e is supposed equal to a, it must be $-\overline{a-b} \times \overline{c-b} \times \overline{d-b}$ when $e = b$; it must be $-\overline{a-c} \times \overline{b-c} \times \overline{d-c}$ when $e = c$; and it must be $-\overline{a-d} \times \overline{b-d} \times \overline{c-d}$ when $c = d$. Now it is manifest that these Products $\overline{b-a} \times \overline{c-a} \times \overline{d-a}$, $\overline{a-b} \times \overline{c-b} \times \overline{d-b}$, $\overline{a-c} \times \overline{b-c} \times \overline{d-c}$, $\overline{a-d} \times \overline{b-d} \times \overline{c-d}$ must be affected with the Signs $+, -, +, -$ respectively; the first being the Product of three positive Quantities, the second the Product of one negative and two positives, the third the Product of two negatives and one positive, and the fourth the Product of three negatives. Therefore since by substituting a, b, c, d for e in the Quantity $4e^3 - 3Ae^2 + 2Be - C$, it becomes alternately a positive and a negative Quantity, it follows from the last Lemma that a, b, c, d must be the *Limits* of the Roots of the Equation $4e^3 - 3Ae^2 + 2Be - C = 0$, or of the Equation $4x^3 - 3Ax^2 + 2Bx - C = 0$.

Cor. It follows from this Theorem, that if a' b' and c' are the three Roots of the Equation $4x^3 - 3Ax^2 + 2Bx - C = 0$, they must be *Limits* betwixt a, b, c, d the Roots of the Biquadratick $x^4 - Ax^3 + Bx^2 - Cx + D = 0$: For if a, b, c, d are *Limits* of the Roots

Roots a', b', and c'; theſe Roots converſely muſt be *Limits* betwixt a, b, c and d.

THEOREM II. Multiply the Terms of any Biquadratick $x^4 - Ax^3 + Bx^2 - Cx + D = 0$ by any Arithmetical Series of Quantities $l + 4m$, $l + 3m$, $l + 2m$, $l + m$, l, and the Roots of the Biquadratick a, b, c, d will be the *Limits* of the Roots of the Equation that reſults from that Multiplication that is of the Equation.

$$\begin{array}{l} lx^4 - lAx^3 + lBx^2 - lCx + lD = 0 \\ +4mx^4 - 3mAx^3 + 2mBx^2 - mCx \end{array}$$

Suppoſe that ſubſtituting the Roots a, b, c, d of the biquadratick Equation $x^4 - Ax^3 + Bx^2 - Cx + D = 0$ ſucceſſively, for x in $4x^3 - 3Ax^2 + 2Bx - C$, the Quantities that reſult are $-R$, $+S$, $-T$, $+Z$; while $x^4 - Ax^3 + Bx^2 - Cx + D$ is in every Subſtitution equal to nothing; and it is manifeſt that the Quantity

$$\begin{array}{l} +lx^4 - lAx^3 + lBx^2 - lCx + lD \\ +4mx^4 - 3mAx^3 + 2mBx^2 - mCx \end{array}$$

will become (when a, b, c, d are ſubſtituted ſucceſſively in it for x) equal to $-mRx$, $+mSx$, $-mTx$, $+mZx$; where the Signs of theſe Quantities being alternately negative and poſitive, it follows that a, b, c, d muſt be *Limits* of that Equation by Lemma xii.

COR. Hence it follows, that a, b, c and d are *Limits* of the Roots of the Cubick Equation $Ax^3 - 2Bx^2 + 3Cx - 4D = 0$, and converſely, that the Roots of this Cubick are *Limits* of the Roots of the biquadratick Equation $x^4 - Ax^3 + Bx^2 - Cx + D = 0$, for multiplying the Terms of this biquadratick Equation by the Arithmetical Progreſſion $0, -1, -2, -3, -4$, the Cubick $Ax^3 - 2Bx^2 + 3Cx - AD = 0$ ariſes.

THEOREM III. *In general, the Roots of the Equation* $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. $= 0$, *are the* Limits *of the Roots of the Equation* $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. $= 0$, *or of any Equation that is deduced from it by multiplying its Terms by any Arithmetical Progression* $l \mp d, l \mp 2d, l \mp 3d$ &c. *and converſely the Roots of this new Equation will be the* Limits *of the Roots of the propoſed Equation* $x^n - Ax^{n-1} + Bx^{n-2}$ &c. $= 0$.

This Theorem is demonſtrated from the xi^th^ and xiii^th^ Lemmata in the ſame manner as the preceeding Theorems were demonſtrated from the xth and xii^th^. From theſe Theorems it is eaſy to infer all that is delivered by the Writers of Algebra on this Subject.

THEOREM IV. *The Equation* $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. $= 0$ *will have as many imaginary Roots as the Equation* $nx^{n-1} - \overline{n-1} \times Ax^{n-2} - \overline{n-2} \times Bx^{n-3}$ &c. $= 0$, *or the Equation* $Ax^{n-1} - 2Bx^{n-2} + 3Cx^{n-3}$ &c. $= 0$.

Suppoſe that any Root of the Equation $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. $= 0$, as p becomes imaginary, and the two Roots of the Equation $x^n - Ax^{n-1} + Bx^{n-2}$ &c $= 0$, which by Theorem III. ought to be its *Limits*, cannot both be real Quantities; for it is manifeſt from the Demonſtration of Theorem I. that if they are real Quantities, then being ſubſtituted for x in $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. the Quantities that reſult muſt have contrary Signs, and conſequently the Root p, whereof they are *Limits*, muſt be a real Root; which

which is againſt the Suppoſition. The ſame is true of the Equation $Ax^{n-1} - 2Bx^{n-2} + 3Cx^{n-3}$ &c. $= 0$, for the ſame Reaſon.

Cor. The biquadratick $x^4 - Ax^3 + Bx^2 - Cx + D = 0$, will have two imaginary Roots, if two Roots of the Equation $4x^3 - 3Ax^2 + 2Bx - C = 0$ be imaginary; or if two Roots of the Equation $Ax^3 - 2Bx^2 + 3Cx - 4D = 0$ be imaginary. But two Roots of the Equation $4x^3 - 3Ax^2 + 2Bx - C = 0$ muſt be imaginary, when two Roots of the Quadratick $6x^2 - 3Ax + B = 0$, or of the Quadratick $3Ax^2 - 4Bx + 3C = 0$ are imaginary, becauſe the Roots of theſe quadratick Equations are the *Limits* of the Roots of that Cubick, by the third Theorem; and for the ſame reaſon two Roots of the Cubick Equation $Ax^3 - 2Bx^2 + 3Cx - 4D = 0$ muſt be imaginary, when the Roots of the quadratick $3Ax^2 - 4Bx + 3C = 0$, or of the quadratick $Bx^2 - 3Cx + 6D = 0$ are impoſſible. Therefore two Roots of the Biquadratick $x^4 - Ax^3 + Bx^2 - Cx + D = 0$ muſt be imaginary when the Roots of any one of theſe three quadratick Equations $6x^2 - 3Ax + B = 0$, $3Ax^2 - 4Bx + 3C = 0$, $Bx^2 - 3Cx + 6D = 0$ become imaginary; that is, when $\frac{3}{8}A^2$ is leſs than B, $\frac{4}{9}B^2$ leſs than AC, or $\frac{3}{8}C^2$ leſs than BD.

Cor. II. By proceeding in the ſame manner, you may deduce from any Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. $= 0$, as many quadratick Equations as there are Terms excepting the firſt and laſt whoſe Roots muſt be all real Quantities, if the

propoſed Equation has no imaginary Roots. The Quadratick deduced from the three firſt Terms $x^n - A x^{n-1} + B x^{n-2}$ will manifeſtly have this Form, $n \times n-1 \times n-2 \times n-3$ &c. $\times x^2 - n-1 \times n-2 \times n-3 \times n-4$ &c. $\times A x + n-2 \times n-3 \times n-4 \times n-5$ &c. $\times B = 0$, continuing the Factors in each till you have as many as there are Units in $n-2$. Then dividing the Equation by all the Factors $n-2$, $n-3$ &c. which are found in each Coefficient, the Equation will become $n \times n-1 \times x^2 - n-1 \times 2 A x + 2 \times 1 \times B = 0$, whoſe Roots will be imaginary by Prop. i. when $n \times n-1 \times 2 \times 4 B$ exceeds $\overline{n-1}|^2 \times 4 A^2$, or when B exceeds $\frac{n-1}{2n} A^2$, ſo that the propoſed Equation muſt have ſome imaginary Roots when B exceeds $\frac{n-1}{2n} A^2$; as we demonſtrated after another Manner in the vth Propoſition. The Quadratick Equation deduced in the ſame Manner from the three firſt Terms of the Equation $A x^{n-1} - 2 B x^{n-2} + 3 C x^{n-3}$ &c. $= 0$, will have this Form $n-1 \times n-2 \times n-3$ &c. $\times A x^2 - n-2 \times n-3 \times n-4$ &c. $\times 2 B x + n-3 \times n-4 \times n-5$ &c. $\times 3 C = 0$; which by dividing by the Factors common to all the Terms, is reduced to $n-1 \times n-2 \times A x^2 - n-2 \times 4 B x + 6 C = 0$, whoſe Roots muſt be imaginary when $\frac{2}{3} \times \frac{n-2}{n-1} \times B^2$ is leſs than $A C$; and therefore in that caſe ſome Roots of the propoſed Equation muſt be imaginary.

Cor. III. In general, let $D x^{n-r+1} - E x^{n-r} + F x^{n-r-1}$ be any three Terms of the Equation, $x^n -$

$A x$

$Ax^{n-1} + Bx^{n-2}$ &c. $= 0$, that immediately follow one another, multiply the Terms of this Equation firſt by the Progreſſion $n, n-1, n-2$, &c. then by the Progreſſion $n-1, n-2, n-3$, &c. then by $n-2, n-3, n-4$, &c. till you have multiplied by as many Progreſſions as there are Units in $n-r-1$: Then multiply the Terms of the Equation that ariſes, as often by the Progreſſion $0, 1, 2, 3$ &c. as there are Units in $r-1$, and you will at length arrive at a Quadratick of this Form,

$$\overline{n-r+1} \times \overline{n-r} \times \overline{n-r-1} \times \overline{n-r-2} \text{ &c.} \times \overline{r-1} \times \overline{r-2} \times \overline{r-3} \times \overline{r-4} \text{ &c.} \; D x^2$$
$$- \overline{n-r} \times \overline{n-r-1} \times \overline{n-r-2} \times \overline{n-r-3} \text{ &c.} \times r \times \overline{r-1} \times \overline{r-2} \times \overline{r-3} \text{ &c.} \times E x$$
$$+ \overline{n-r-1} \times \overline{n-r-2} \times \overline{n-r-3} \times \overline{n-r-4} \text{ &c.} \times \overline{r+1} \times r \times \overline{r-1} \times \overline{r-2} \text{ &c.} \times F = 0,$$

and dividing by the Factors $n-r-1, n-r-2$, &c. and $r-1, r-2$ &c. which are found in each Coefficient, this Equation will be reduced to $\overline{n-r+1} \times \overline{n-r} \times 2 \times 1 \times D x^2 - \overline{n-r} \times 2 \times r \times 2 E x + 2 \times 1 \times \overline{r+1} \times r F = 0$, whoſe Roots muſt be imaginary (by Prop i.) when $\frac{n-r}{n-r+1} \times \frac{r}{r+1} \times E^2$ is leſs than DF. From which it is manifeſt that if you divide each Term of this Series of Fractions $\frac{n}{1}, \frac{n-1}{2}, \frac{n-2}{3}, \frac{n-3}{4}$, &c. $\frac{n-r+1}{r}, \frac{n-r}{r+1}$ by that which preceeds it, and place the Quotients above the Terms of the Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. $=$

&c. = 0, beginning with the ſecond: Then if the Square of any Term multiplied by the Fraction over it be found leſs than the Product of the adjacent Terms, ſome of the Roots of that Equation muſt be imaginary Quantities. There remain many things that might be added on this Subject, but I am afraid you will think I have ſaid as much of it as it deſerves; and therefore I ſhall only add the Demonſtration of ſome Algebraick Rules and Theorems that are very eaſily deduced from the xi^th Lemma.

I. The Rule for diſcovering when two or more Roots of an Equation are equal, immediately follows from that Lemma, Suppoſe that two Roots of the Equation $x^n - Ax^{n-1} + Bx^{n-2} - Cx^{n-3}$ &c. = 0 are equal, and two Values of y (which is equal always to $x-e$) will be equal. Suppoſe that e is equal to one of thoſe two equal Values of x; and two Values of y will vaniſh, and conſequently y^2 muſt enter each of the Terms of the Equation of y; and therefore in this Caſe the firſt and ſecond Term of the Equation of y in Lemma xi^th muſt vaniſh, that is, $e^n - Ae^{n-1} + Be^{n-2} - Ce^{n-3}$ &c. = 0 and $ne^{n-1} - \overline{n-1} \times Ae^{n-2} + \overline{n-2} \times Be^{n-3} - \overline{n-3} \times Ce^{n-4}$ &c. = 0 at the ſame time; and conſequently theſe two Equations muſt have one Root common, which muſt be one of thoſe Values of x that were ſuppoſed equal to each other. It is manifeſt therefore that when two Values of x are equal in the Equation $x^n - Ax^{n-1} + Bx^{n-2}$ &c. = 0, one of them muſt be a Root of the Equation $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. = 0.

If three Values of x be ſuppoſed equal amongſt themſelves and to e, then three Values of y ($= x - e$) will vaniſh, and the firſt three Terms of the Equation of y in

in Lemma xi. will vaniſh, and therefore $n \times \overline{n-1} \times e^{n-2} - \overline{n-1} \times \overline{n-2} \times Ae^{n-3} + \overline{n-2} \times \overline{n-3} \times Be^{n-4}$ &c $= 0$; and one of the equal Values of x will be a Root of this laſt Equation, and two of them will be Roots of the Equation $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. $= 0$. In general, it appears that if the Equation $x^n - Ax^{n-1} + Bx^{n-2}$ &c. $= 0$ have as many Roots equal amongſt themſelves as there are Units in S, then ſhall as many of thoſe be Roots of the Equation $nx^{n-1} - \overline{n-1} \times Ax^{n-2} + \overline{n-2} \times Bx^{n-3}$ &c. $= 0$ as there are Units in S $-$ 1; as many of them ſhall be Roots of the Equation $n \times \overline{n-1} \times x^{n-2} - \overline{n-1} \times \overline{n-2} \times Ax^{n-3} + \overline{n-2} \times \overline{n-3} \times Bx^{n-4}$ &c. $= 0$, as there are Units in S $-$ 2; and ſo on.

II. The general Rule which Sir *Iſaac Newton* has given in the *Article de limitibus Equationum* for finding a *Limit* greater than any of the Values of x immediately follows from the xith Lemma; for it is manifeſt that if e be ſuch a Quantity as ſubſtituted in all the Coefficients of the Equation of y, *viz.* in $e^n - Ae^{n-1} + Be^{n-2}$ &c. $ne^{n-1} - \overline{n-1} \times Ae^{n-2} + \overline{n-2} \times Be^{n-3}$ &c. $n \times \frac{n-1}{2} \times e^{n-2} - \overline{n-1} \times \frac{n-2}{2} \times Ae^{n-3} + \overline{n-2} \times \frac{n-3}{2} \times Be^{n-4}$ &c. gives the Quantities that reſult all poſitive; then there being no Changes of the Signs of the Equation of y in this caſe, all its Values muſt be negative; and ſince y is always equal to $x - e$ it follows that e muſt be a greater Quantity than any of the Values of x; that is, it muſt be a

Limit

Limit greater than any of the Roots of the Equation $x^n - Ax^{n-1} + Bx^{n-2}$ &c. $= 0$.

III. From this xi^th Lemma ſome important Theorems in the Method of *Series*, and of *Fluxions*, and the Reſolution of Equations are demonſtrated with great Facility; it is obvious that the Coefficient of the ſecond Term of the Equation of y in that Lemma is the *Fluxion* of the firſt Term divided by the *Fluxion* of e; the Coefficient of the third Term is the ſecond *Fluxion* of that firſt Term divided by $2\dot{e}^2$; ſuppoſing e to flow uniformly. The third Term is the third *Fluxion* of the firſt Term divided by $2 \times 3\,\dot{e}^3$; and ſo on. Therefore ſuppoſing $e^n - Ae^{n-1} + Be^{n-2}$ &c. $= c$, the Equation for determining y will be $c + \frac{\dot{c}}{\dot{e}}y + \frac{\ddot{c}}{1 \times 2\,\dot{e}^2}y^2 + \frac{\dddot{c}}{1 \times 2 \times 3\,\dot{e}^3}y^3$ &c. $= 0$; and hence, when e is near the true Value of x, Theorems may be deduced for approximating to y, and conſequently to x, which is ſuppoſed equal to $y + e$.

IV. Let AP $(= x)$ be the Abſciſs and PM $(= z)$ the Ordinate of any Curve BLM; and ſuppoſe any other Abſciſs AK $= e$ and Ordinate KL $= c$, then ſhall $z\,(= \text{PM}) = c \mp \frac{\dot{c}}{\dot{e}}y + \frac{\ddot{c}}{2\dot{e}^2}y^2 \mp \frac{\dddot{c}}{2 \times 3\,\dot{e}^3}y^3 + \frac{\ddot{\dot{c}}}{2 \times 3 \times 4\,\dot{e}^4}y^4$ &c.

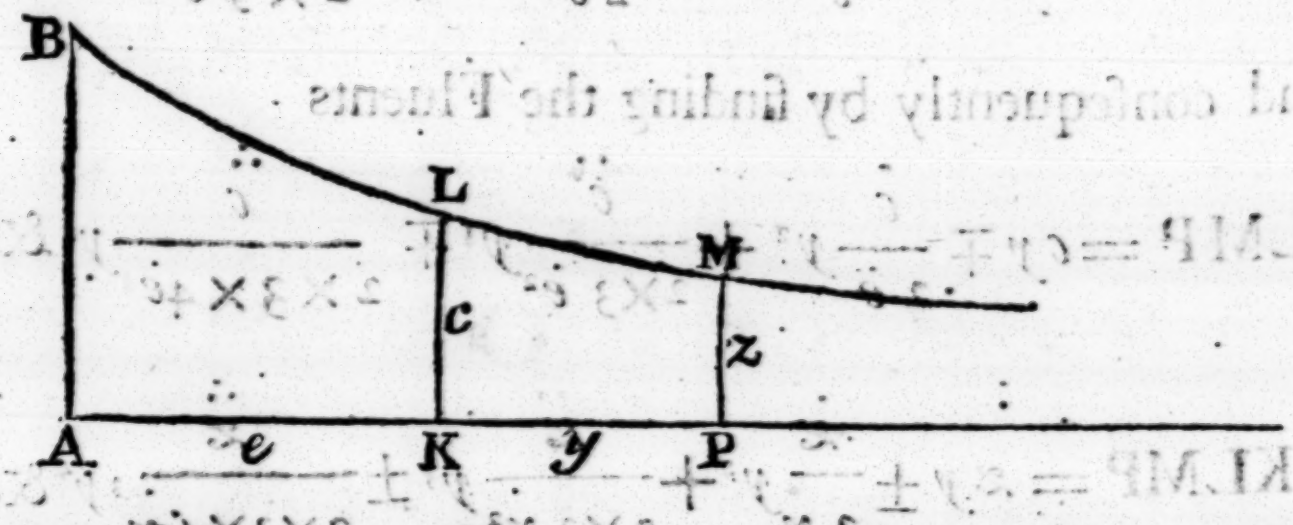
For let z be ſuppoſed equal to any Series conſiſting of given Quantities, and the Powers of x, as to $Ax^n + Bx^r + Cx^s$ &c. and ſubſtituting $e \mp y$ for x, we ſhall find after the manner of the xi^th Lemma,

$$x = Ae^{n} \mp nAe^{n-1}y + n \times \frac{n-1}{2} \times Ae^{n-2}y^2 \&c.$$

$$\pm Be^{r} \mp rBe^{r-1}y + r \times \frac{r-1}{2} \times Be^{r-2} \times y^2 \&c.$$

$$+ Ce^{s} \mp sCe^{s-1}y + s \times \frac{s-1}{2} \times Ce^{s-2}y^2 \&c.$$

&c. &c. &c.



But when $x = e$ then $z = c = Ae^{n} + Be^{r} + Ce^{s}$ &c. $\dot{c} = nAe^{n-1}\dot{e} + rBe^{r-1}\dot{e} + sCe^{s-1}\dot{e}$ &c. $\ddot{c} = n \times \overline{n-1} \times Ae^{n-2}\dot{e}^2 + r \times \overline{r-1} \times Be^{r-2}\dot{e}^2 + s \times \overline{s-1} \times Ce^{s-2}\dot{e}^2$ &c. and therefore $z = c \mp \frac{\dot{c}}{\dot{e}}y + \frac{\ddot{c}}{2\dot{e}^2}y^2 \mp \frac{\dddot{c}}{2 \times 3\dot{e}^3}y^3$ &c. After the same manner you will find that $c = z \pm \frac{\dot{z}}{\dot{x}}y + \frac{\ddot{z}}{2\dot{x}^2}y^2 \pm \frac{\dddot{z}}{2 \times 3\dot{x}^3}y^3$ &c. for $c = Ae^{n} + Be^{r} + Ce^{s}$ &c. $= A \times \overline{x \pm y}^{n} + B \times \overline{x \pm y}^{r} + C \times \overline{x \pm y}^{s}$ &c. $= z \pm \frac{\dot{z}}{\dot{x}}y + \frac{\ddot{z}}{2}$

$+\frac{\ddot{z}}{2\dot{x}^2}y^2$ &c. The Area KLMP is equal to the Fluent of zy or of cy, but

$$cy = zy \pm \frac{\dot{z}}{\dot{x}}yy + \frac{\ddot{z}}{2\dot{x}^2}y^2y \pm \frac{\dddot{z}}{2\times 3\dot{x}^3}y^3y \text{ \&c.}$$

and $$zy = cy \mp \frac{\dot{c}}{\dot{e}}yy + \frac{\ddot{c}}{2\dot{e}^2}y^2y \mp \frac{\dddot{c}}{2\times 3\dot{e}^3}y^3y \text{ \&c.}$$

And consequently by finding the Fluents

$$KLMP = cy \mp \frac{\dot{c}}{2\dot{e}}y^2 + \frac{\ddot{c}}{2\times 3\dot{e}^2}y^3 \mp \frac{\dddot{c}}{2\times 3\times 4\dot{e}^3}y^4 \text{ \&c.}$$

$$\text{or } KLMP = zy \pm \frac{\dot{z}}{2\dot{x}}y^2 + \frac{\ddot{z}}{2\times 3\dot{x}^2}y^3 \pm \frac{\dddot{z}}{2\times 3\times 4\dot{x}^3}y^4 \text{ \&c.}$$

This laſt is the Theorem publiſhed by the learned Mr. *Bernouilli* in the *Acta Lipſiæ* 1694. It is now high Time to conclude this long Letter; I beg you may accept of it as a Proof of that Reſpect and Eſteem with which

I am,

SIR,

Your moſt Obedient,

Moſt Humble Servant,

Colin Mac Laurin.

Numb. 409.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *May* and *June*, 1729.

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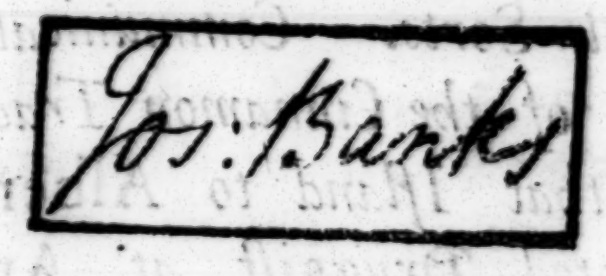
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LONDON:

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I. *An Account of the Cinnamon Tree in* Ceylon, *and its ſeveral Sorts. Communicated by the Chief Inſpector of the Cinnamon Trade and Manufacture in that Iſland to* Albertus Seba, *a noted Druggiſt at* Amſterdam. *Tranſlated by the late Dr.* Scheuchzer, *F. R. S.*

THE firſt and beſt Sort of Cinnamon, which grows in great Plenty in *Ceylon*, and is peculiar to that Iſland, is call'd by the Natives *Raſſe Coronde*, which is as much as to ſay, ſharp, ſweet Cinnamon. 'Tis this choice Sort, which is exported Yearly by the *Dutch Eaſt-India-Company*, by whom it hath been prohibited under ſevere Penalties, that no other Sort whatever ſhould be mix'd with it.

The ſecond Sort is call'd *Canatte Coronde*, that is, bitter and adſtringent Cinnamon; for the *Ceyloneſe*, in their Language, call Cinnamon in general *Coronde*, and *Canatte* ſignifies bitter and adſtringent. The Bark of this Tree comes off very eaſily, and ſmells very agreeably when freſh, but hath a bitter Taſte. It is an Advantage to us, that it doth not grow in great Plenty hereabouts, becauſe elſe one might eaſily miſtake it for a better; as indeed, in general, it requires a good deal of Skill and Attention ſo to diſtinguiſh the Cinnamon Trees from each other, as not to chooſe now and then a worſe Sort for the beſt. The Root of this ſecond Tree yields a very good ſort of Camphire.

† See the origin of this memoir with figures of the leaves of several sorts of cinnamon in acta Physico-medica Academiæ Cæsareæ naturæ curiosorum Vol. 1 mem. appendix printed after p. 568.

The third Sort is call'd by the *Ceyloneſe*, *Cappe-roe Coronde*, which is as much as to ſay, Campho-rated Cinnamon, becauſe it hath a very ſtrong Smell and Taſte of Camphire. It grows plentifully enough in the Iſland, but not in the Eaſtern Parts of it: How-ever, they find Means now and then to ſend it over privately, and ſell it to the *Danes* and *Engliſh*, who come to Trade upon the Coaſts of *Cormandel*; for as long as there is but one Port in the Iſland left open, abundance of this ſort of bad Merchandize may be exported. Beſides, there is a ſort of a *Canella*, grow-ing upon the Continent of *India*, about *Goa*, which is very like this ſort of Cinnamon Tree, though it hath nothing of the true Cinnamon. The ſame ſort of *Canella* agrees in many Things with the *Canella Ma-labarica Sylveſtris*, a wild Cinnamon Tree, growing upon the Coaſts of *Malabar*. And although with regard to the Shape of the Tree, and the outward Ap-pearance of the Bark and Leaves, there is very little Difference to be obſerved between theſe two ſorts of *Canella*, and the above-mentioned firſt and good ſort of Cinnamon, yet the latter is vaſtly ſuperior in Rich-neſs, Virtue and Sweetneſs.

The fourth Sort of Cinnamon is called by the *Cey-loneſe*, *Welle Coronde*, that is, the *Sandy Cinnamon*, becauſe upon chewing it, one feels as it were, Bits of Sand between the Teeth, though in Fact there is no-thing Sandy in it. The Bark of this Tree comes off eaſily enough, but is not ſo eaſily roll'd up into a fi-bular Form, as other ſorts of Cinnamon are, being apt to burſt open and to unfold it ſelf. It is of a ſharp and bitteriſh Taſte, and the Root of it yields but a ſmall Quantity of Camphire.

The fifth Sort is called *Serwel-Coronde*, *Serwel* in the *Ceyloneſe* Language ſignifies mucilaginous, or glutinous. This ſort of Cinnamon acquires, in drying, a very conſiderable Degree of Hardneſs, which upon chewing of it ſufficiently ſhews it ſelf. It hath otherwiſe but little Taſte, and an ungrateful Smell; but the Colour of it is very fine, and it is not many Years ſince I firſt took Notice, that the Natives, who are all Blacks, mix a good deal of this mucilaginous Cinnamon along with the firſt and beſt Sort, the Colour of both being very much alike, excepting only, that in the good Sort there are ſome few yellowiſh Spots appear towards the Extremities.

The ſixth Sort is called by the Natives *Nieke Coronde*, the Tree which bears it, having a good deal of Reſemblance to another Tree, which is by them called *Nieke Gas*, and the Fruit it bears *Nieke*. The Bark of this ſort of Cinnamon Tree, hath no manner of Taſte or Smell, when taken off, and is made uſe of by the Natives only in Phyſick. For by roaſting of it they obtain a Water and Oil, which they anoint themſelves withal, thinking thereby to keep off all ſorts of noxious Fumes, and Infections in the Air. They likewiſe expreſs a Juice out of the Leaves of it, which they ſay cools and ſtrengthens the Brain, if the Head be rubb'd with it.

The ſeventh Sort is called *Dawel-Coronde*, that is, Drum-Cinnamon, in *Low Dutch Trommel-Caneel*: The Reaſon of this Appellation is, becauſe the Wood of this Tree, when it is grown hard enough, is light and tough, and that Sort, of which the Natives make ſome of their Veſſels and Drums, which they call *Dawel*. The Bark is taken off, when the Tree

grows as yet, and is of a pale Colour: The Natives uſe it in the ſame Manner with the ſixth Sort.

The eighth Sort is called *Catte-Coronde*, that is, the thorny or prickly Cinnamon; *Catte*, in the *Ceyloneſe* Language, is a Thorn, or Prickle; accordingly this Tree is very prickly. The Bark is in ſome Meaſure like Cinnamon, but the Leaves d ffer very much, and the Bark it ſelf hath nothing either of the Taſte or Smell of Cinnamon. The Natives uſe the Root, Bark and Leaves of this Tree in Phyſick, applying them in Form of Cataplaſms, to Tumours and Swellings from a thick corrupt Blood, which they ſay it cures in a ſhort Time.

The ninth Sort is called *Mael Coronde*, or the Flowering Cinnamon, becauſe this Tree is always in Bloſſom. The Flowers come neareſt to thoſe of the firſt and beſt Sort, called *Raſſe Coronde*, but they bear no Fruit, which the other doth. The Subſtance of the Wood becomes never ſo ſolid and weighty in this, as in the other Cinnamon Trees above-mentioned, which have ſometimes eight, nine, or ten Feet in Circumference. If this everflowering Cinnamon Tree be cut, or bored into, a limpid Water will iſſue out of the Wound, as it doth out of the *European Birch Tree*, but it is of no Uſe, no more than the Leaves and Bark.

The Inhabitants of *Ceylon* ſay, that there is ſtill another Sort of Cinnamon, which they call *Toupat Coronde*, or the three Leave Cinnamon. It doth not grow in that Part of the Country which the *Dutch Eaſt-India* Company is poſſeſs'd of, but higher up towards *Candia*. Having never ſeen it my ſelf, I will alſo, out of regard to Truth, ſay nothing farther of it.

And

And thus, Sir, I have given you, I hope, a ſatisfactory Account of the ſeveral Sorts of Cinnamon Trees growing in this Country. I can aſſure you, that you are the firſt to whom I ever communicated ſo particular a Deſcription; for having been for almoſt theſe fifteen Years laſt paſt, employed as chief Inſpector of the Cinnamon Trade and Manufacture here, I have with much Pains and Attention, ſo ſtrictly enquired into this Matter, that at laſt I found out all the ſeveral ſorts of bad Cinnamon, which were formerly mix'd with the true and good one; and have been able to ſhew Samples of the Bark, Root and Leaves of every one of them to our Directors, who thereupon, to ſhew their Satisfaction, that a Thing of that Conſequence was at laſt, after many laborious Searches diſcovered, and thinking it a Thing well worth a farther Enquiry, were pleaſed to augment the Yearly Salary annex'd to this Office.

It now remains, that I ſhould inform you, in how many Years the Cinnamon Trees grow ripe enough, and become fit to have the Bark ſtript off. And here I will confine my ſelf only to the firſt and beſt Sort, which is Yearly exported by the Company, and what I ſhall mention of it, may ſerve at the ſame Time to anſwer in ſome Meaſure ſuch Queries as might be made about the others.

All the ſeveral ſorts of Cinnamon Trees, the beſt as well as the reſt, muſt grow a certain Number of Years, before the Bark is fit to be taken off: With this Difference however, that ſome of the Trees of the ſame ſort, as for Inſtance of the firſt and beſt, will ripen two or three Years ſooner than others, which is owing to the Difference of the Soil they grow in; thoſe for In-

ſtance, which grow in Vallies, where the Ground is a fine whitiſh Sand (and there are many ſuch Vallies in the Iſland of *Ceylon*) will in five Years Time be fit to have the Bark taken off: Others on the contrary, which ſtand in a wet ſlimy Soil, muſt have ſeven or eight Years Time to grow, before they are ripe enough. Again, thoſe Trees are later, which grow in the Shade of other larger Trees, whereby the Sun is kept from their Roots: And hence alſo it is, that the Bark of ſuch Trees hath not that Sweetneſs and agreeable Taſte obſervable in the Bark of thoſe Trees which grow in a white Sandy Ground, where with little Wet they ſtand full expoſed to the Sun, but is rather of a bitteriſh Taſte, ſomething adſtringent, and ſmells like Camphire.

For by the Heat of the Sun's Rays the Camphire is made ſo thin and volatile, that it riſes up and mixes with the Juices of the Tree, where it undergoes a ſmall Fermentation, and then riſing ſtill higher between the Subſtance of the Wood, and the thin inner Membrane of the Bark, it is at laſt ſo effectually diffuſed through the Branches and Leaves, that there is not the leaſt Footſtep of it to be perceived any where. Mean while that thin and glutinous Membrane, which lines the Bark on the Inſide between it and the Subſtance of the Wood, attracts and ſucks in all the pureſt, ſweeteſt, and moſt agreeable Particles of the Juice, leaving the thick and groſs ones, which are puſh'd forward, and ſerve to nouriſh the Branches, Leaves, and Fruit.

What I here mention, is conform to my own Obſervations, and I have often had Occaſion to prove this Fact to curious Perſons by the Things themſelves. For if the Bark be freſh taken off, that Juice which

remains

remains in the Tree hath a bitterish Taste, not unlike that of Cloves. On the contrary, if you taste the inner Membrane of the Bark, when fresh taken off, you'll find it a most exquisite Sweetness, extreamly agreeable to the Taste, whereas the outward Part of the Bark differs but very little in Taste from the common Trees; which shews plainly that all the Sweetness of it is owing only to the inner Membrane. But when the Bark is laid in the Sun in order to its being dried and wound up, this Oily and agreeable Sweetness of the inner Membrane communicates and diffuses it self also throughout the whole outward Part of it (which however hath been first stripp'd, when as yet upon the Tree, of its outermost greenish Coat) and imbues it so strongly, as to make the Bark a Commodity, which for the Fragrancy of its Smell, and the Sweetness of its Taste, is coveted all over the World.

It may not be amiss to take Notice also, how many Years the Cinnamon Trees, when they are once come to a full Maturity, will continue in that State, so that the Bark, when taken off, shall have lost nothing of its Sweetness and Virtue. And in order to clear up this Point, it must be observed, that the Bark may as yet be taken off from Trees which have stood fourteen, fifteen, or sixteen Years, according to the Quality of the Soil they stand in: But beyond that Time they grow thicker, and lose, by Degrees, their Taste and agreeable Sweetness, which makes the Bark have more of the Taste of Camphire: Besides, the Bark is then grown so thick, that if it be laid in the Sun, it will no longer shrink and wind it self up, but remain flat.

And here it may be thought a fit Subject of Enquiry, how it comes to paſs, that conſidering what vaſt Quantities of Cinnamon have been exported from this Iſland, and ſold all over the World, by the *Europeans* as well as Natives, not only for theſe two hundred Years laſt paſt; and ſince the Way thither by the *Eaſt-Indies* hath been found out by the *Portugueze*, but for ſeveral Centuries before (for it was diſcovered and known long before) I ſay, how, conſidering this, it comes to paſs, that there are yet ſuch Numbers of good Trees fit to be Bark'd, remaining in the Iſland and growing there every Year? Now in order to ſolve this Queſtion, ſeveral Authors, who deſcrib'd the Iſland of *Ceylon*, committed a conſiderable Miſtake, when they aſſure their Readers, that when the Bark hath been ſtripp'd off the Tree, it grows again in four or five Years, and becomes fit to be ſtripp'd a ſecond Time. I can aſſure you, Sir, that this Aſſertion is entirely contrary to the Courſe of Nature and Obſervation: Nor do I believe, that there is any one Tree whatever in any Part of the World, which, if it was entirely ſtripp'd of its Bark, could ſubſiſt and grow any longer: That Part at leaſt, where the Bark hath been taken off, will quickly grow dry, and ſo die away; but the Root in the mean while remains entire and in good Condition; and this ſhews the Reaſon why there is ſuch a Number of Trees fit to be Bark'd every Year. For although the Cinnamon Trees, after the Bark hath been once taken off, is cut down to the very Root, as they do in *Europe* Oaks, Birch-Trees, Alders and Willows, yet the Root will quickly puſh forth new Shoots, which will ripen in a ſhort Time, I mean in five, ſix, ſeven or eight Years, ſome ſooner, ſome later, and then yield their Quantity

tity of the Bark. Hence it appears, how far the old Roots are inſtrumental to the Growth and Plenty of Cinnamon Trees, but the Fruit which falls from the Trees, contributes very much towards the ſame End: And it is particularly owing to a certain kind of wild Doves, which from their feeding on the Fruit of the Cinnamon-Tree, they call *Cinnamon-eaters*, that theſe Trees grow ſo plentifully in this Iſland; for the Doves, when they fetch Food for their young ones, flying here and there, diſperſe vaſt Quantities of the Fruit all over the Fields, which occaſions the Riſe of many thouſand young Trees, which one ſhall ſee here and there along the Roads in ſuch Quantities together, that they look like a little Wood. So plentifully grows this excellent Tree in this Iſland; I call it excellent, becauſe indeed I don't know of any other that is preferable to it. I need not point out to you what remarkable Foot-ſteps of Divine Providence the Hiſtory of the Cinnamon Tree affords to an attentive Eye.

There is hardly any thing ſo univerſally grateful, and eſteemed by all Nations, as true Cinnamon. The Oil drawn out of it by Fire is reckoned one of the ſtrongeſt Cordial Medicines: The Camphire which comes out of the Root, is likewiſe of great Uſe in ſeveral Diſtempers, as are alſo the Oil of Camphire, a very coſtly Thing, the Leaves of the Tree, and the Oil diſtilled out of them; and laſtly, the Fruits with their Oil. In ſhort, there is no Part of the Cinnamon Tree, but what is of ſome ſingular Uſe or other in Phyſick. I purpoſely avoid ſpeaking of the large Gains the Company makes by the yearly Export of this precious Commodity.

Some Additions to the foregoing Account, by Albertus Seba. *F. R. S.*

AS a farther Explanation of this curious Account of the Cinnamon Trees, it will not be amiſs to ſubjoin the following Obſervations. Having ſome Years ago bought out of the *Eaſt-India* Company's Warehouſes at *Amſterdam*, a conſiderable Quantity of Cinnamon Leaves, or *Folia Malabathri*, pack'd up in ſeveral large Cheſts, I happen'd to find in one of them the Flowers of the Cinnamon, as big as the *Italian* Bean-flowers, and of a blue Colour; I chanced likewiſe to meet with the Fruit. But I could not find either in any of the other Cheſts.

In 1722 and 1723, I bought of the ſame Company the Oil, which is expreſſed out of the Fruit of the Cinnamon Tree, as alſo that which is boil'd out of them, which is of a very good Conſiſtence and white, and is by the *Eaſt-India* Company called Cinnamon Wax, becauſe the King of *Candia* cauſes Candles to be made out of it, which for their agreeable Scent, are burnt only by himſelf and at his Court. However he permits his Subjects to expreſs the Juice out of another Fruit, not unlike the Fruit of the Cinnamon Tree; but this Juice being only a thin fat Subſtance, like Oil of Olives, they cannot burn it any otherwiſe but in Lamps.

The *Indians* uſe this Cinnamon Wax alſo in Phyſick, and give it inwardly in Luxations, Fractures, Falls, Contuſions and Bruiſes, that in caſe any inward Part be touch'd or bruiſed, it may by its Balſamick

Virtues heal them. They give it alſo in Bloody Fluxes to one Dram or a Dram and a half. Outwardly applied, it makes the Skin more beautiful, ſmoother and ſofter, than any one known ſort of Pomade.

The Leaves of the Cinnamon Tree yield alſo an Oil, which is of a bitteriſh Taſte, reſembling Oil of Cloves mix'd with a little good Oil of Cinnamon. It is called *Oleum Malabathri*, or Oil of Cinnamon Leaves. It is an Aromatick, and is reckoned an excellent Remedy in Headaches, Pains of the Stomach, and other Diſtempers.

The Oil of the Root of the Cinnamon Tree is, properly ſpeaking, an Oil of Camphire, the Roots affording a good Quantity of Camphire. About two Years ago, or ſomewhat longer, I bought a Bottle of it of our *Eaſt-India* Company at my own Price. There were ſeveral Bottles together in a Box, upon which was wrote in Low Dutch *Deſe Oliteyten ſyn tot cen geſchenk nyt Candia geſchikt*; that is, *theſe Oils were ſent as a Preſent out of* Candia, which ſhews that they are genuine, without any Adulteration; accordingly they are very much eſteemed. If this Oil be diſtilled in Glaſs Veſſels, there comes over along with it, that ſort of Camphire which the *Indians* call *Camphire Baros*, or Camphire of *Borneo*, which ſhoots in thin tranſparent Chriſtals, forming a beautiful Variety of Trees on the Recipient, not unlike thoſe, which in very froſty Weather are to be ſeen upon Windows. This ſort of Camphire is of very great Efficacy in Phyſick, and is gathered and kept for the King of *Candia* his own Uſe, who eſteems it an excellent Cordial Medicine. But not only the Camphire of *Baros*, but alſo the Oil of Cam-

phire, which is drawn out of the Roots of the Cinnamon Tree, is a very great Cordial, if taken inwardly: It ſtrengthens the Stomach, expels Wind, and hath been found of great Uſe in arthritick and gouty Diſorders: It is alſo a Diuretick. The Doſe is ten or twelve Drops upon a bit of Sugar, or in a proper Vehicle. Outwardly it is applied in all arthritick Pains from Cold and Obſtructions, being rubb'd on the affected Part with a warm Hand, and it will preſently leſſen the Pain, and by Degrees take it off. It is now about ſix and thirty Years ſince, ſerving in the Shop of Mr. *Nicolas Dumbſtdorff* at *Amſterdam*, that Gentleman was then ſo cruelly afflicted with arthritick Pains, that he could have no Reſt neither Night nor Day; and although he called in the Aſſiſtance of ſeveral noted Phyſicians, and tried abundance of Medicines, yet he could find no Relief, till he was adviſed to cauſe himſelf to be anointed with the Oil of the Root of the Cinnamon Tree; of which he then happen'd to have a good Quantity by him. I remember very well, that I anointed him my ſelf, rubbing the Oil on all the affected Parts with my Hand warm'd by holding it to an Oven, and this I did twice every Day for an Hour together. And though, when this Cure was firſt begun with him, his Hands and Feet were by the Convulſions and the Violence of his Pain ſo contracted, that they grew quite crooked, and were full of Nodes, yet in a Fortnight's Time he grew ſo much better, that he could ſleep well at Nights, feeling neither Pains nor Cramps. In about ſix Weeks Time he could walk about his Room, whereas before the Anointing he was not able to ſtir either Hand or Foot. This Anointing was continued for about three Months, when the Patient not only recover'd of

that

that violent Indiſpoſition, but continued free from the Gout ever after, and lived about fifteen Years in a very good State of Health. And this I cannot only affirm to be true of my own certain Knowledge; but alſo, that ſince that Time I have adviſed ſeveral People in his Condition to do the ſame with as good Succeſs. Several Phyſicians have wrote largely of the Virtues of common Camphire, but there are as yet many hidden Qualities in this excellent Medicine. Thus, for Inſtance, I can affirm, that in all Burnings, by Fire or otherwiſe, in any Part of the Body, and the Pains occaſioned thereby, I have not yet met with any better and ſurer Medicine than this following.

℞. *Spir. Lumbricor. terreſtr. cum Spir. Vini rectificat* ℥xij. *Camphor.* ℥ij. M.

No ſooner is a Bandage, or Compreſs, dipp'd into this Spirit, applied to the affected Part, but it will give inſtant Relief, and ſo effectually check the Inflammation, that it will creep no farther. But the Application of it muſt be continued till the Pain is quite gone, and the *Ulcus*, if there hath been any, is dried up. If the Exulceration is got deeper, and the Wound muſt be kept open, two Ounces of Camphire diſſolved in *Oleo Hyperici*, mix'd with a Pound of the common *Unguentum Ceruſſæ*, applied according to Art, will quickly and effectually heal it, as I have often experienced.

II. *The*

II. *The Bills of Mortality in ſeveral Parts of* Europe, *for the Years* 1724 *and* 1725. *Extracted from the* Acta Breſlavienſia, *by the* Same.

For the Year 1724.

A Liſt of thoſe that were Born and Buried at Breſlaw *in the Year* 1724.

Perſons.		Among the Dead were,	
From the 25th to the 31ſt of *Dec.* 1723.	17	Married Men	231
January 1724.	115	Married Women	148
February	101	Widows and Widowers	154
March	129	Batchelors	57
April	79	Maidens	66
May	122	Children to 10 Years of Age. Boys	417
June	99	Children to 10 Years of Age. Girls	326
July	129	Still-born Boys	36
Auguſt	177	Still-born Girls	31
September	141	Total	1466
October	134	*Chriſtened*	
November	126	Males	709
1 *Dec.* to 24 *Dec.*	97	Females	613
Sum Total	1466	Total	1322

Married 386 Pairs.

In

In *Vienna.*

Buried 5524, among whom

3	of	90	
2	—	92	
2	—	93	
5	—	95	
2	—	96	
1	—	97	Years of Age.
3	—	98	
1	—	99	
2	—	100	
3	—	101	
2	—	103	
1	—	106	
27	of	90	and upwards.

Chriſtened 4427.

At *Lübau.*

Buried 135
Chriſtened 166
Married 38 Pairs

At *Lauban.*

Chriſtened

Boys	107
Girls	116
Total	223

Buried

Buried	Married Men		29
	Married Women		19
	Batchelors		7
	Maidens		15
	Children	Boys	68
		Girls	61
	Infants		23
	Still-born		17
	Widows and Widowers		18

257. Among which there died 97 Children of the *Small-Pox*.

There were married 73 Couple.

At *Dreſden*

Chriſtened	Boys		715
	Girls		712
	Baſtards	Boys	60
		Girls	70
		Total	1557

Buried

Buried	Married Men		161
	Married Women		151
	Widowers		35
	Widows		143
	Batchelors		72
	Maidens		71
	Children	Boys	522
		Girls	508
	Still-born	Boys	58
		Girls	40
		Total	1761. Being 204 more than were Chriſtened.

Married Couple 413.

At *Leipſick.*

Chriſtened	in *January*	79	in *July*		78
	February	71	*Auguſt*		94
	March	99	*Sept.*		79
	April	78	*October*		79
	May	74	*November*		50
	June	69	*December*		63
		470			443
					470
				Total	913

Chriſtened in all 913. Boys 491, Girls 422; among whom there were three Children at one Birth, born the 31ſt of *October*, one being alive, the two others Still-born, beſides 14 Twins.

Buried in	*January*	53	Among which	Married Men	122
	February	78		Married Women	81
	March	87		Batchelors	51
	April	109		Maidens	44
	May	100		Children Boys	234
	June	74		Children Girls	210
	July	90		Women in Childbed	17
	August	86		Infants Boys	59
	September	77		Infants Girls	28
	October	73		Still-born Boys	33
	November	70		Still-born Girls	28
	December	64		Widows & Widowers	54
	Total	961		Total	961

Married Couple 276.

At *Erfurt*.

Christened	659
Buried	612
Married Couple	188

At *Salfeld*.

Christened	119
Buried	90
Married	24 Couple.

At

At *Gera.*

Buried	Married Men	28	
	Married Women	15	
	Widowers	4	
	Widows	22	
	Batchelors	6	
	Maidens	4	
	Children Boys	76	Including 10 Still-born.
	Children Girls	42	
	Total	197	
Chriſtened	Boys	153	Including 6 Twins; one of which was Still-born.
	Girls	143	
	Total	296	

Married Couple 82

At *Berlin.*

Chriſtened	2798
Buried	2492
Married Couple	864

In all the King of Prussia's *Dominions.*

	Born.	Married Couple.	Buried.
In the Kingdom of *Prussia*	21685	4611	13680
Churmarck Brandenburg	19507	5019	12949
New Marck	7044	1838	4285
Dukedom of *Magdeburg* and County of *Mansfeld*	8584	2073	6035
Dukedom of *Cleves* and County of *Marck*	6949	2071	7182
Dutchy of *Pomerania*	8168	1949	5670
Principality of *Halberstadt*	2889	781	2326
County of *Hohnstein*	593	171	399
Principality of *Minden*	2203	684	2030
County of *Ravensberg*	2417	680	2166
Principality of *Mirs*	426	166	529
Dukedom of *Geldren*	1861	420	1860
County of *Teklenburg*	497	146	517
County of *Lingen*	769	255	647
Lauenburg and *Butow*	607	133	361
French Colonies	711	185	546
Total	84910	21182	61182

Among the Christened were 2215 Bastards. Among the Dead 66, who lived to 90, and upwards as far as 100.

At

At *Regenſpurg*, among the Proteſtants,

Chriſtened	Boys	172		
	Girls	126		
	Total	298.	Among which were 5 Twins.	
Buried	Married Men		34	
	Married Women		46	Including 13 Widows and four that died in Child-bed.
	Batchelors		13	
	Maidens		7	
	Children	Boys	79	
		Girls	110	
		Total	289	
Married Couple			68	

At *Amſterdam.*

Buried	7622
Married	2294

At *Venice.*

Buried	4590
Born	5046

At *Copenhagen.*

Chriſtened	Boys	1306
	Girls	1183
	Total	2489

Buried

Buried	Men	486
	Women	343
	Boys	991
	Girls	931
	Total	2751.

Being 262 more than were born, and 837 more than there died in this City the Year before; this extraordinary Mortality being aſcribed to the Small-Pox being very rife.

Married Couple 748

At *Dantzick.*

Chriſtened	1999
Married Couple	488
Buried	1872, or 377 more than the Year before.

Bills of Mortality for the Year 1725.

At *Breſlau.*

From *Dec.* 25 to 31, 1724.	30
January 1725	125
February	115
March	129
April	166
May	122
June	106
July	121
Auguſt	107
September	115
October	141
November	97
Dec. 1, to 24	67
Total	1441

Among which

Married Men		25
Married Women		153
Widows and Widowers		158
Batchelors		64
Maidens		58
Children to 10 Years of Age	Boys	364
	Girls	306
Still-born	Boys	44
	Girls	35
		1441

Chriſtened

1

Chriſtened Boys 664
Girls 675
Total 1339
Married 363 Couple.

At *Vienna.*

Buried Men 1007
Women 1433
Boys 1865
Girls 1560
Total 5865. Among which

8	of	90
1	—	91
3	—	92
2	—	93
1	—	94
3	—	95
2	—	96
2	—	98
1	—	99
3	—	100
1	—	102
1	—	103
1	—	106

29 of 90 and upwards.

Chriſtened 4708

At *Dreſden.*

Chriſtened Boys 758
Girls 714
Baſtards { Boys 68
Girls 60
Total 1600

Buried

Buried Married Men 225
Married Women 174
Widowers 36
Widows 65
Batchelors 99
Maidens 167
Children { Boys 478 / Girls 398 } amongwhich, { Boys 53 / Girls 33 } Still-born
Total 1642

Married Couple 519

At *Leipsick.*

Christened Boys 478
1 *Jew*, 20 Years of Age.
Girls 461
Total 940. Among which were Posthumous Births 6
Twins 12
Bastards 141, and among them 3 Twins.

Married 260 Couple.

Buried

Buried	Married Men	113	
	Married Women	75	
	Batchelors	49	
	Maidens	34	
	Boys	165	
	Girls	106	
	Women in Childbed	10	
	Children { Boys	58	
	Children { Girls	51	
	Still-born { Boys	45	
	Still-born { Girls	24	
	Widows and Widowers	77	
	Total	807	

At *Erfurt.*

Buried 617
Chriſtened 624
Married 183 Couple.

At *Coburg.*

Chriſtened Boys 105
Girls 101
206. Among which 3 Twins and 8 Baſtards.

Buried	Married Men	35	
	Married Women	35	
	Women in Childbed	2	
	Batchelors	4	
	Maidens	10	
	Children	96.	Six of which were Still-born.
	Total	182	

According to the Months.

	Christenings	Burials		Christenings	Burials
January	17	22	*July*	12	18
February	27	13	*Auguſt*	10	14
March	24	18	*Sept.*	21	13.
April	18	20	*Oct.*	23	15
May	16	11	*Nov.*	11	9
June	15	10	*Dec.*	12	19
	117	94		89	88
				117	95
			Total	206	183

Married Couple 46

At *Regenſpurg* among the Proteſtants.

Chriſtened Boys 142
Girls 126
268. Among which 4 Twins.

Buried
Married Men 42
Married Women 39
Batchelors 13
Maidens 11
Children { Boys 58 / Girls 50
Total 213

Married Couple 80

At

At *Franckfort* on the *Mayn.*

Chriſtened	Boys	346
	Girls	385
		731. Including 10 Twins, 4 Poſthumous Births, 1 *Jew*, 2 Foundlings, and 22 Baſtards.
Buried		843

Chriſtened at *Sachſenhauſen*

Boys	87
Girls	79
166.	Including 2 Twins and 9 Baſtards.

Buried at *Sachſenhauſen* 168

Married Pairs at *Franckfort* and *Sachſenhauſen* 209.

Marriages at *Amſterdam* in the Reformed Church.

In	1724	2294
	1725	2249

At *Venice.*

Born	4836
Buried	4816

At *Dantzick.*

Chriſtened	2012
Buried	1678
Married Couple	46

P. S. *The Publiſher is informed that this will be the laſt Account that will be given in ſo particular a Manner: The Univerſity of* Breſlaw *deſigning for the future to give only a general Table, as practiſed in* London.

III. *Part of a Letter from the Reverend Mr.* Benjamin Colman, *of* Boſton *in* New England, *to the late Biſhop of* Peterborough; *giving an Account of the late Earthquake which happened there. Communicated by Dr.* Jurin. *R. S. S. &c.*

Boſton, Sept. 5, 1728.

My Lord,

YOUR Lordſhip hopes that ſome of our accurate Obſervers took Notes of the Symptoms and Incidents of our late Storms and Earthquake, to communicate to the Royal Society, for the more critical Enquiry into the Cauſes and Effects of this. How much Mr. *Dudley* or Dr. *Mather*, the Gentlemen here of Learning, who had the Honour to be Fellows of that learned Body, may have done this, I know not. The Earthquake came ſuddenly upon us in the Night after the Lord's Day, *Octob.* 29, 1727, between ten and eleven, in a very ſtill and fair Evening; the Stars ſo bright and glittering, that many had taken great Notice of them, and one or two Perſons that had been in Places ſubject to Earthquakes, had ſaid tranſiently, that if we had been us'd to have 'em, they ſhould expect one. This only general Symptom of its Approach I have heard of, namely, the moſt ſerene Sky and calm Air that was ever known, not a Cloud in the Sky, nor ſcarce a Breath of Wind. And though this is not univerſally a Symptom when Earthquakes

are

are coming on Places, yet ſo far as I can inform my ſelf, it has often and for the moſt Part been obſerved. It was ſo in the dreadful Shake at *Jamaica* thirty odd Years ago; and a moſt ingenious and obſerving Friend of mine who had his Leg broke on the Point when it ſunk, and is ſtill living, tells me, That after that Shock, which was follow'd with many Tremblings and leſſer Shakes while his Leg was healing, he could from Day to Day judge by the Face of the Sky and Air, whether there would be any Tremor or Jar of the Earth. If there was any Cloud hanging over the Mountainous Part of the Iſland, there was no Shake that Day; but if all was ſerene and fair, he expected one, and it ſeldom failed. Yet it has not been found ſo with us, in our After-rumbles and Tremblings, which returned often for ſome Months after the great Shake, and at Times for nine Months after it.

The Town of *Newbury*, at the Mouth of *Merrimack* River, about forty Miles *North Eaſt* from *Boſton*, is the Place that ſeems to have been the Center of the Shock and Shakes felt by us. There the Earth open'd and threw up many Cart-loads of a fine Sand and Aſhes, mix'd with ſome ſmall Remains of Sulphur; but ſo ſmall, that taking up ſome of it in my Fingers, and dropping it into a Chafin-diſh of bright Coals, in a dark Place, once in three Times the blue Flame of the Sulphur would plainly ariſe, and give a ſmall Scent, and but a ſmall one. By this it ſeems evident that it was a ſulphurous Blaſt which burſt open the Ground, and threw up the calcin'd bituminous Earth. The Family neareſt to this Eruption, it being in that Part of the Town where the Houſes lie at a Diſtance from each other, were in the Terrors

of Death; the Roar and Shock being much more terrible upon them than upon others: And yet upon us at forty Miles Diſtance, and upon others at forty and forty more, it was very terrifying and aſtoniſhing.

Five or ſeven ſmall Shakes were felt by us, after the firſt and great one, that Night and in the Morning following; but theſe and other following Rumbles and Tremblings, were louder and greater at *Newbury* and the adjacent Places than with us; and they felt and heard many Times when our Parts did not; but yet from Week to Week, we and the Places about us felt and heard ſome of the greater Tremors, both by Day and Night.

Upon receiving your Lordſhip's Letter I have made what Enquiry I could, and have receiv'd from a Reverend Miniſter in *Newbury* * the following Account.

* Mr. *Lowell.*

As to any previous Notices of the Approach of the Earthquake, I cannot find any thing to be depended on. The Prognoſtications that have been among us have all fail'd; ſuch as the Brightneſs of the Sky beyond what was common; the twinkling of the Stars, and the like. I certainly know that we have heard the Rumbles in all Weathers, cloudy, foggy, rainy, ſnowy, clear, cold, hot, moderate, windy, calm, *&c.* indifferently; and at all Hours of Day and Night: (Tho' by the way, we heard theſe Rumbles oftner in the Night during *Winter*, as I think, and ſince more uſually in the Day) Alſo when the Wind has been at any Point of the Compaſs, and at all Times of Tide; and as to the Moon equally when ſhe was nearer or further from her Change or Full: Neither in any particular Weather, nor on any obſervable Occaſion were the Shocks greater, or Rumbles louder. As

As to any Alterations in the Air or Water after a Shock, I could never diſcern any thing; particularly as to the Wind being raiſed after a Shock, when it was calm before, which ſome reported, I could never perceive the leaſt Difference.

One Thing I may add here, very remarkable, and which may be depended on. About the Middle of *April*, that fine Sand which was thrown up in ſeveral Places in this Pariſh at the firſt great Shock, *Octob.* 29, did actually ſtink to a very great Degree, even ſo as to be more nauſeous than a putrefying Corpſe; yet in a very little while after it did not ſmell at all. How long it was before it began to ſtink I am not certain; I know it did not at firſt, and I believe it was cover'd with Snow till a little while before: There is nothing of Smell now. There has been no Opening of the Ground, throwing up Sand, ſtopping or breaking out of Springs, *&c.* as at firſt. If there had continued any ſenſible Evacuating of Air or other Matter pent up in the Earth, from the Surface of the Sea or Land adjacent to us, at the Times of our many Rumbles and Tremblings, we ſhould have diſcern'd it before now. *Newbury* is a Spot of Ground, and ſo the adjacent Towns, very much inhabited and continually travell'd over; and as to the Sea contiguous to theſe Parts, it is full of our Coaſters by Day and Night; but neither on Land or Water have any ſenſible Eruptions or Evacuations been obſerved that I hear of.

P. S. *Boſton Weekly News Letter*, *Sept.* 5, 1728. We hear from *Newbury* and *Rawley*, That they felt the Shake of the Earth on *Tueſday* laſt about Four in the Morning; the Noiſe much like Thunder.

IV. *A Propoſition on the* Balance, *not taken Notice of by Mechanical Writers, explain'd and confirm'd by an Experiment before the Royal Society, by* J. T. DESAGULIERS, L. L. D. F. R. S.

THO' the following Theorem is agreeable to, and deducible from, Mechanical Principles, yet as it has not been taken Notice of by Mechanical Writers, though often talk'd of among Handicraft Workmen, I thought it might not be improper to take Notice of it here, and to make an Experiment agreeable to the Demonſtration.

THEOREM, *Figure* 1.

A B is a Balance, on which is ſuppos'd to hang at one End B the Scale E with a Man in it, who is counterpoiſed by the Weight W hanging at A, the other End of the Balance. I ſay, that if ſuch a Man, with a Cane or any rigid ſtreight Body, puſhes upwards againſt the Beam any where between the Points C and B (provided he does not puſh directly againſt B) he will thereby make himſelf heavier, or over-poiſe the Weight W, though the Stop G G hinders the Scale E from being thruſt outwards fromwards C towards G G. I ſay likewiſe, That if the Scale and Man ſhould hang from D, the Man by puſhing upwards againſt B, or any where between B and D (provided he does not puſh directly againſt D) will make himſelf lighter, or be

Fig. 1.

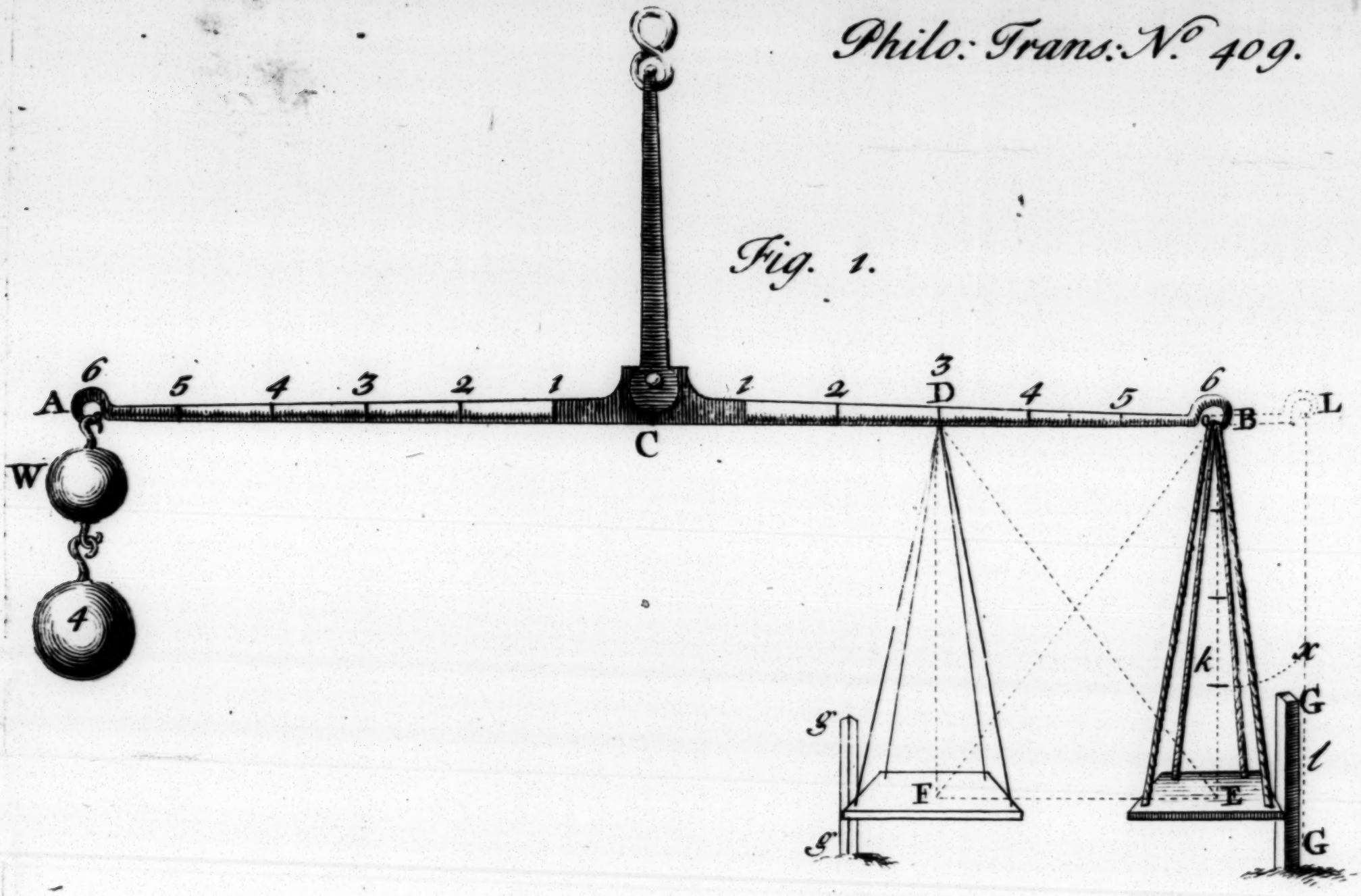
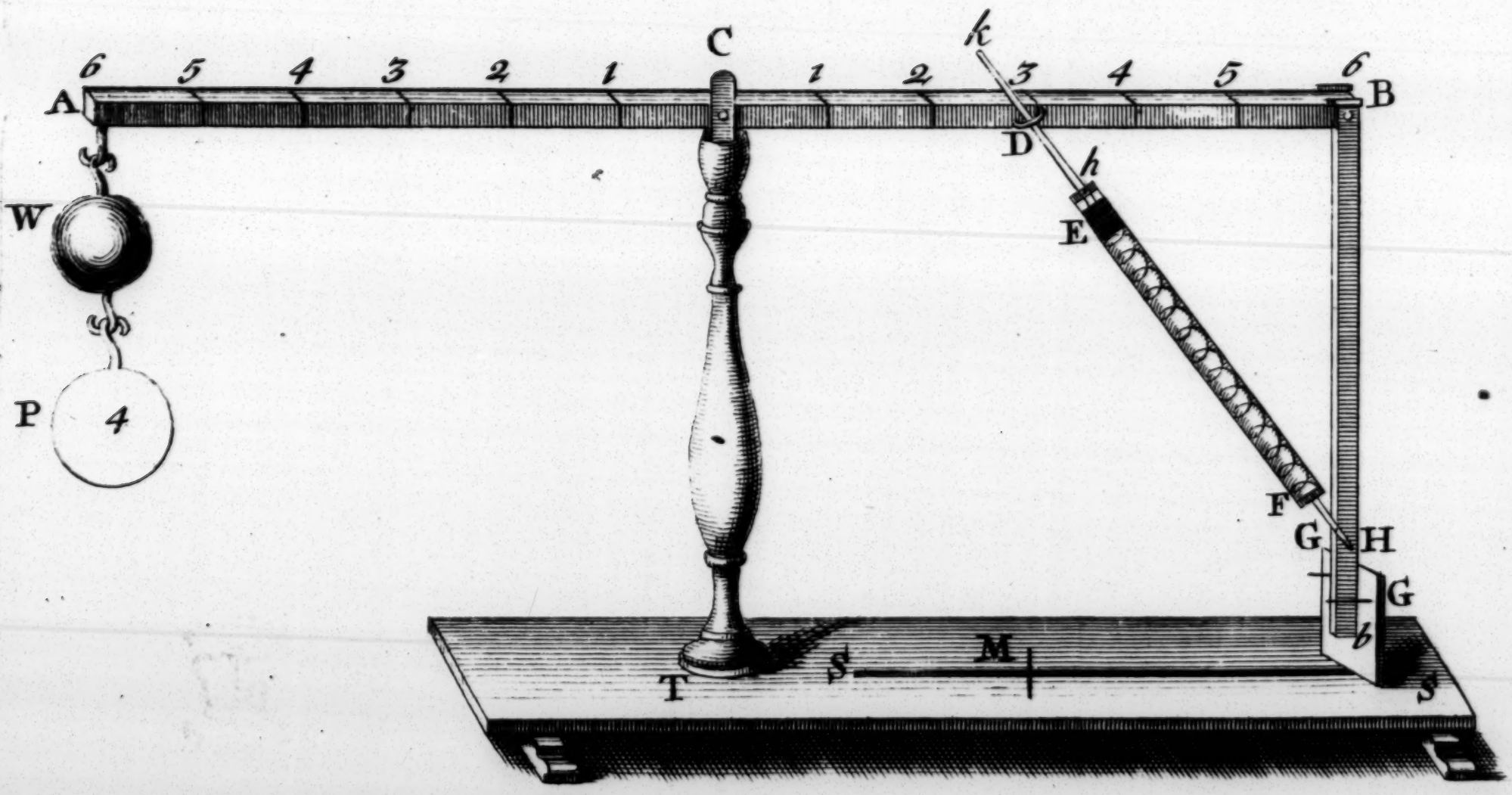

A
6
5
4
3
2
1
C
1
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3
D
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5
6
B
L
W
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g
k
x
G
l
E
G

Fig. 2.


A
6
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3
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B
D
h
E
W
P
4
F
G
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G
b
T
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M
S

be over-poiſed by the Weight W, which did before only counterpoiſe the Weight of his Body and the Scale.

If the common Center of Gravity of the Scale E, and the Man ſuppoſed to ſtand in it be at *k*, and the Man by thruſting againſt any Part of the Beam, cauſe the Scale to move outwards ſo as to carry the ſaid common Center of Gravity to *k x*, then inſtead of B E, L *l* will become the Line of Direction of the compound Weight, whoſe Action will be encreaſed in the Ratio of L C to B C. This is what has been explain'd by ſeveral Writers of Mechanicks; but no one, that I know of, has conſider'd the Caſe when the Scale is kept from flying out, as here by the Poſt G G, which keeps it in its Place, as if the Strings of the Scale were become inflexible. Now to explain this Caſe, let us ſuppoſe the Length B D of half of the Brachium B C to be equal to 3 Feet, the Line B E to 4 Feet, the Line E D of 5 Feet to be the Direction in which the Man puſhes, D F and F E to be reſpectively equal and parallel to B E and B D, and the whole or abſolute Force with which the Man puſhes, equal to (or able to raiſe) 10 Stone. Let the oblique Force E D (= 10 Stone) be reſolv'd into the two E F and E B, (or its Equal F D) whoſe Directions are at right Angles to each other, and whoſe reſpective Quantities (or Intenſities) are as 6 and 8, becauſe E F and B E are in that Proportion to each other, and to E D. Now ſince E F is parallel to B D C A, the Beam, it does no way affect the Beam to move it upwards; and therefore there is only the Force repreſented by F D, or 8 Stone to puſh the Beam upwards at D. For the ſame Reaſon, and becauſe Action and Reaction are equal, the Scale will be puſh'd down at E with the Force of 8 Stone

alſo. Now ſince the Force at E pulls the Beam perpendicularly downwards from the Point B, diſtant from C the whole Length of the Brachium BD, its Action downwards will not be diminiſhed, but may be expreſs'd by $\overline{8 \times BC}$: Whereas the Action upwards againſt D will be half loſt, by reaſon of the diminiſh'd Diſtance from the Center, and is only to be expreſs'd by $\overline{8 \times \frac{BC}{2}}$; and when the Action upwards to raiſe the Beam is ſubſtracted from the Action downwards to depreſs it, there will ſtill remain 4 Stone to puſh down the Scale; becauſe $\overline{8 \times BC} - \overline{8 \times \frac{BC}{2}} = 4\,BC$. Conſequently a Weight of 4 Stone muſt be added at the End A to reſtore the Æquilibrium. *Therefore a Man*, &c. *puſhing upwards under the Beam between* B *and* D, *becomes heavier*. Q. E. D. On the contrary, if the Scale ſhould hang at F from the Point D, only 3 Feet from the Center of Motion C, and a Poſt *g g* hinders the Scale from being puſh'd inwards towards C, then if a Man in this Scale F puſhes obliquely againſt B with the oblique Force above-mention'd; the whole Force, for the Reaſons before given (in reſolving the oblique Force into two others acting in Lines perpendicular to each other) will be reduc'd to 8 Stone, which puſhes the Beam directly upwards at B, while the ſame Force of 8 Stone draws it directly down at D towards F. But as CD is only equal to half of CB, the Force at D compar'd with that at B, loſes half its Action, and therefore can only take off the Force of 4 Stone from the Puſh upwards at B; and conſequently the Weight W at A will preponde-

rate,

rate, unleſs an additional Weight of 4 Stone be hanged at B. *Therefore a Man*, &c. *puſhing upwards under the Beam between* B *and* D *becomes lighter.* Which was alſo to be demonſtrated.

SCHOLIUM I.

Hence knowing the abſolute Force of the Man that puſhes upwards, (that is, the whole oblique Force) the Place of the Point of Truſion D, and the Angle made by the Direction of the Force with a Perpendicular to the Beam at the ſame Point, we may have a general Rule to know what Force is added to the End of the Beam B in any Inclination of the Direction of the Force or Place of the Point D.

RULE *for the firſt Caſe.*

Firſt find the perpendicular Force by the following Analogy, whoſe Demonſtration is known to all that underſtand the Application of oblique Forces.

As the Radius:
To the right Sine of the Angle of Inclination:
So is the oblique Force:
To the perpendicular Force.

Then the perpendicular Force multiplied into the Length of the Brachium B C, *minus* the ſaid Force multiplied into the Diſtance D C, will give the Value of the additional Force at B, or of the Weight requir'd to reſtore the Æquilibrium at A.

Or to expreſs it in the Algebraical Way. Let *o f* expreſs the oblique Force, *p f* the Perpendicular Force,

and x the Force requir'd, or Value of the additional Weight at A to reſtore the Æquilibrium.

$$DE : DF :: of : pf$$

$$\overbrace{pf \times BC} - \overbrace{pf \times DC} = x$$

The ſame Rule will ſerve for the ſecond Caſe, if the Quantity found be made negative, and the additional Weight ſuſpended at B. Or having found the Value of the Perpendicular Force, the Æquation will ſtand thus $\overbrace{-pf \times BC} + \overbrace{pf \times DC} = -x$, and conſequently the additional Weight muſt be hanged at B; becauſe $-x$ at A is the ſame as $+x$ at B.

Scholium II.

Hence it follows alſo, that if, in the firſt Caſe, the Point of Truſion be taken at C, the Force at B, (or Force whoſe Value is requir'd) will be the whole Perpendicular Force; becauſe C D is equal to nothing: And if the Point D be taken beyond C towards A; the Perpendicular Force puſhing upwards at that *Point*, multiplied into D C, muſt be added to the ſame Force multiplied into B C, that is $\overbrace{pf \times BC} + \overbrace{pf \times DC} = x$.

The Machine I made uſe of to prove this experimentally, was as follows. *Fig.* 2. The Braſs Balance A B is 12 Inches long, moveable upon the Center C, with a Perpendicular Piece *B b* hanging at the End B, and moveable about a Pin at B, and ſtopp'd at its lower End *b* (by the upright Plate G G) from being thruſt out of the Perpendicular by the puſhing Pipe F E, whoſe lower Point being put into a little Hole at H, the upper Wire or Point (when put into another little Hole under the Beam at D) is by Means of the

Worm-ſpring E F preſſing againſt the Plug E to drive forwards the ſaid Wire *b* D, made to puſh the ſaid Beam upwards with the Force of the Spring. T S S is a Stand, to which is fix'd the Pillar T C that ſuſtains the Balance; and it has alſo a Slit S S to receive a Shank of the moveable Plate G G, to be fix'd in any Part of the Slit by a Screw underneath.

EPERIMENT.

Hang on B *b*, as in the Figure. Then let E F be ſo applied to the Hole H, that its upper Wire *b* D *k* may go through a little Loop at D ſo as not to thruſt the Beam upwards, but be in the ſame Poſition as if it did, that by hanging on the Weight W, the Brachium B C with B *b* and F E may be counterpois'd; and then the Action againſt D and H may be eſtimated without the Weight of the puſhing Pipe.

Then drawing down the End of the Wire *k*, thruſt it into the little Hole under D, and B will be ſo pull'd downwards as to require the additional Weight of 4 Ounces to be hung on at A to reſtore the Æquilibrium, when B H is 4 Inches, B D 3 Inches, and the whole Force of the Spring equal to 10 Ounces.

I need not here ſay, that for explaining the ſecond Caſe, B *b* is to be ſuſpended at D, with the Plate G G fix'd to ſtop it at the Place M to keep it from being puſh'd towards T, and that the upper End of G F E D *k* muſt puſh into an Hole made under B, in which Caſe the Weight P muſt be hang'd at B to reſtore the Æquilibrium.

P. S.

P. S. To ſhew experimentally that the Force which the Spring exerts in this oblique Truſion is equal to 16 Ounces: Take the Beam A B, which weighs 4 Ounces, from its Pedeſtal C T, and having ſuſpended at each End, A and B 3 Ounces, ſupport it under its Center of Gravity by the puſhing Pipe E F ſet upright under it, and you will find that the Beam with the two Weights will thruſt in the Wire *k b* as far as *b*, the Place which the oblique Truſion drives it to.

Jos: Banks

Numb. 410.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *July*, *Auguſt*, and *September*, 1729.

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IX. *Obſervationes quædam Eclipſeos Lunaris Die* 29 Julii *habitæ, A. D.* 1729.

I. *A Letter to Sir* Hans Sloane, *Bart. R.S.Pr.&c. containing a Deſcription of ſome uncommon Appearances obſerved in an* Aurora Borealis, *by the Reverend Mr.* Derham, *Canon of* Windſor, *and F. R. S.*

Honoured SIR,

THE *Lumen Boreale* is of late ſo common a *Phœnomenon*, that I ſhould not think it worth troubling you with that of *Sunday Oct.* 13 laſt, but that I obſerved ſome very different Appearances of it at *Redbridge* in *Hants*, near *Southampton*, where I then was on our College Buſineſs.

About 8 in the Evening of that Day, my Family and others at *Windſor*, ſaw a conſiderable *Streaming* in the *North*, with ſuch bright Lances and Columns as uſual. But at *Redbridge* none ſuch appeared, only in the *North*, I obſerved a great thick, black Bank of Vapours; the Top reaching about 20° above the Horizon, without any Convexity or Curvature, as is uſual in moſt of the *Streamings* I have ſeen; but inſtead of that, the upper Part was indented in many Parts, with long black Pyramids, ſomewhat reſembling the Streams of the *Lumen boreale*, the Edges of which were gilded with lucid Rays, of the Streaming Colour: And all over the Clouds, or Vaporous Bank, I diſcovered a great Commotion or Diſturbance behind them, as if ſomething was rolling, or tumbling behind them. The End of all theſe Appearances I

expected would have been *Streaming*: But in leſs than an Hour, the Clouds (which had been pretty ſtill) began to move to the *S. W.* and at laſt obſcured the whole Hemiſphere; which before was all clear enough (except towards the *North*) to ſhew the Stars, although beſpread with Vapours, like a thin Fog, a little inclining to red.

This Relation I thought it convenient to give you, and the Illuſtrious Society, becauſe it may aſſiſt ſuch as are wiſer than my ſelf to diſcover the Nature of this difficult *Phœnomenon*.

Your much obliged

Humble Servant,

W. DERHAM.

II. *A remarkable Conformation of the Urinary Parts, communicated in a Letter to the* Same, *by Mr.* John Budgen.

I Am adviſed to communicate to you a very uncommon Caſe, which I met with in my Country Practice, and is as follows.

In *Villâ Com' Surriæ, Ockley* vulgò dictâ, anno 1711 nata eſt Infantula, cujus in Tergo, circa vertebras inferiores, apparuit Tumor indolens, cutis colorem,

rem, Oviq; columbini majuſculi magnitudinem referens, qui cum Puellâ tantoperè concrevit, ut circitèr nonum, vel decimum ætatis annum, ubi primùm conſpexi, Veſicam vitulinam, aëre diſtentam, ſed ſine Cervice, planè repræſentaverit. Anno præſenti (*viz.* 1728.) Veſicæ bubulinæ magnitudinem æquabat. Die 29 Jan. proxime elapſo in Lecto jacenti diſruptus eſt hic Tumor, a quo multum Liquoris, inſtar Urinæ profluebat. Re perſpectâ, invenimus Tunicas (& interiùs Materiam mucoſam) Ureteres, Venas, & Arterias, tales omninò, quales Veſica habere conſuevit: nec defuit commercium quoddam cum Partibus internis per foramen in vertebris Digitum hominis minorem in Abdomen admittens, quod Vaſa memorata recipiebat. 2° Die Feb. 1728, horam circiter decimam nocturnam obijt Puella; & ſi Cadaver aperire per Parentes, huic Rei ſtrenuè reclamantes, licuiſſet, credor quidèm in Abdomine, Veſicæ Cervicem, & nullam aliam Veſicam inveniremus; non enìm poſt ruptum Tumorem vel ſemèl minxerat.

Dat. 3° *Die Feb.* 1728.

I hope you'll be pleaſed to take this in good Part, from,

S I R, your very

humble Servant,

Darking, Ap. 18, in *Surry*, 1729.

JOHN BUDGEN.

III. *An Obſervation of the Eclipſe of the Moon, by* Arthur Dobs, *Eſq; at* Caſtle-Dobbs *near* Carrickfergus *in* Ireland, Feb. *the* 2*d*, 1728-9; *communicated by* Oliver St. John, *Eſq; F.R.S.*

Caſtle-Dobbs, Feb. *the* 8*th*, 1728-9.

Dear SIR,

HAving had a fine Obſervation of the Eclipſe of the Moon which happened laſt *Sunday* Evening, I have ſent you it to communicate to the *Royal Society*, to aſcertain our Longitude here, and in other Places where it was obſerved.

The Obſervation was made by a nine Foot Glaſs. Having adjuſted a monthly Pendulum Clock by a Meridian Line on the 30th of *Jan.* and further corrected by the Meridian, *Feb.* the 6th 1728-9.

Hours apparent Time.

h	′	″	
p. m. 6	27	0	Penumbra obſerved.
	29	30	Moon's Limb immerged.
	33	0	Eaſtern Limit of Palus Mareotis immerged.
	35	50	Mons Climan. immerged.
	42	40	Mons Porphyrites immerged.
	50	0	Inſula Melis immerged.
	52	40	Mons Ætna immerged.
	54	20	Inſ. Sardinia immerged.
	56	20	Inſ. Rhodes immerged.
	58	0	Inſ. Corſica immerged.

h 7 - 0′

Hours apparent Time.

h	′	″	
p. m. 7 -	0 -	30 - -	Mons Sinai's, Eaſtern Limit immerged.
	2 -	0 - -	Mons Sinai totally immerged.
	6 -	50 - -	Inſ. Besbicus, Eaſtern Limit immerged.
	11 -	50 - -	Mons Herminius immerged.
	13 -	50 - -	Promontory Archeroulia im.
	22 -	0 - -	Mare Caſpium, Eaſtern Limit immerged.
	24 -	20 - -	Palus Mæotis, Eaſtern Limit immerged.
	27 -	30 - -	Palus Mæotis, totally immerg.
	30 -	15 - -	Moon totally immerged.
9 -	8 -	30 - -	Moon's Eaſtern Limb emerged near Mons Acabe.
	13 -	0 - -	Palus Mareotis emerged.
	15 -	0 - -	Mons Climan. emerged.
	23 -	30 - -	Mons Porphyrites emerged.
	29 -	10 - -	Mons Sinai emerged.
	33 -	30 - -	Mons Ætna emerged.
	49 -	0 - -	Inſ. Besbicus emerged.
10 -	1 -	0 - -	Mare Caſpium, Eaſtern Limit emerged.
	5 -	0 - -	Palus Mæotis emerged.
	10 -	0 - -	A Penumbra obſerved, the Moon's Limb emerging.
	11 -	0 - -	The Limb evidently emerged.

From the Beginning to the End of the Eclipſe 3^h $44'$
Totally Eclipſed —— 1^h $38'$ $15''$

IV. *De*

IV. *De Frigidæ in Febribus Uſu. Auctore Cl.* Nicolao Cyrillo *Prim. Med. Prof.* Neapol. & *R. S. S.*

USUS Frigidæ & Frigidorum in Febribus haud recens eſt, ſed apud Antiquiſſimos Medicos minimè infrequens fuit. In Febribus enim calidioribus, poſt Paroxyſmi ἄκμὴν, liberaliorem Aquæ, vel cujuſpiam refrigerantis liquoris potationem concedebant, quâ deferveſcente febrili æſtu, Æger placidè conquieſcens in criticum ſæpenumerò ſudorem exſolveretur. Verùm Febres curare *ſolâ nivatâ Aquâ* copioſiſſimè per plures dies exhibitâ, omni ſubtracto medicamento alimentoque, id quidem omninò novum exiſtimo; atque non ſolum inſolenter, ſed, ut verum fatear, audacter nimis, non multis ab hinc annis hîc tentatum, methodo, ut rumor fuit, ab Hiſpaniâ, rudi & indigeſto Commentariolo communicatâ: quâ curandi ratione nonnullos ex ipſis Orci fauçibus, præter omnem expectationem, ereptos ſub oculis noſtris attoniti vidimus. Hæſere primùm cauti Medici tantâ Aquæ alluvie perteriti: at frequenti feliciſſimoque eventu excitati, tentabundi primùm, mox audaciores facti, quod quidam cæco impetu, & nullo morbi, morbique temporum diſcrimine aggrediebantur, ad cautiorem & ſecuriorem methodum redegere: ita ut nullus jam apud nos ſit Medicus, qui Cleophantus δοσίψυχρος (ut notat Harduinus in Plinium, Lib. 26.) appellari nolit. Hujus Methodi Canones repetitis experimentis confirmatos exponam. Magnum enim remedium eſt Diæta Aquea, (hoc nomine appellare libuit) quare in illius adminiſtratione,

quemadmodùm in omnium magnorum remediorum uſu, accuratiſſimis cautionibus procedendum, ne quod pro Ægrotantis ſalute inſtituitur, illius potius necem moliatur.

Præcipuus Canon eſt, ut poſt aliquot horarum à cibo abſtinentiam, Ventriculo ſcilicet omninò vacuo, Aqua nive refrigerata ebibi incipiat, ad libram unam vel duas, pro Ægrotantis ætate, viribus, aut etiam ſiti. Eadem copia ſingulis horis, aut ſecundâ quâque, ut tardius, repetenda, eademque noctu diuque, nullâ factâ intermiſſione niſi per ſubrepentem fortaſsè ſomnum, exhibeatur. A Cibo omninò abſtinere debent Ægrotantes: Experientiâ enim conſtitit, illum cum Aquâ copiosâ permiſtum, non ſolùm in Venticulo putredinem concipere, verùm etiam ab eodem epotæ Aquæ ſubſtantiam infici, eamque minùs aptam reddi, quæ facilè exiliſſima vaſcula permeare, adeoque in extima ſimul & intima corporis dijici ac diffundi poſſit, ad præcipitationem & ſecretionem noxiorum humorum moliendam. Inedia hæc ad plures dies producenda, quouſque ſcilicet Febris vel prorſùs intermiſerit, vel ad ſummam remiſſionem devenerit, atque Æger identidem de fame conqueri incipiat: ſi enim maturiùs exhibeatur Cibus, ſtatim Febris ſuis ſtipata Symptomatibus iterum recrudeſcet. Quapropter nonnunquam ad ſeptem, imò ad decem & plures dies (dummodò ab Aquâ non abſtineatur) Ægrotantes ab omni alimento prohibemus. Neque ab hâc abſtinentiâ quidquam metuendum: vel quòd ob Aquæ frigiditatem, arctioribus redditis cutis ſpiraculis, Tranſpiratio inſenſibilis, adeoque nutritionis neceſſitas imminuatur; vel quòd Aqua ipſa Nutrimenti Officinas aſſiduò

aſſidùò præterfluens, ſi quæ inibi ſunt alimentorum reliquiæ (ſunt autem ſemper impactæ) eas ſecum rapiat, atque per univerſum Corpus diffundens, nutricationis negotio, quoad fieri poteſt, conſulat. Quomodocumque autem ſe res habeat, illud quotidianâ praxi confirmatum eſt, Cibum cum copiosâ Aquâ commiſceri, abſque ſummo Ægri periculo, non poſſe: ita ut quamprimùm Cibus Ægrotanti conceditur, ille vel abſque Potu, vel cum exiguâ Aquæ potatione exhibendus: imò concedendum quoque eſt aliquot horarum intervallum à Frigidæ potu vacuum, quo commodè Cibus in Ventriculo digeri queat.

Hic ſeligendus tenuiſſimus & εὐπεπτ1Ϙ, ut Panis purâ Aquâ coctus, Paſtilli de micâ Panis, Ovum ſorbile, vel vix ferculum aliquod jurulentum. Hæc ſemel primùm & pauciſſima, hinc bis in die exhibenda, ut ſenſim ad lautiuſculum prandium, ſervatâ tamen exiguâ cœnâ, gradum faciamus: omninò verò, etiam per menſem & ultrà, carnibus parcendum. Cum hujus generis Cibo veſcuntur Ægri, haud Aquæ valedicendum, ſed peractâ illius aſſumti digeſtione, ad duas vel tres potationes erunt cogendi: quouſque integrè devicto morbo, corporis vires ſenſim recuperantes, ad diu exoptatam convaleſcentiam perducantur.

In hujus autem Curationis curriculo quædam accuratè animadvertenda ſunt. Principem locum tenet Obſervatio, num Aqua aſſumta facilem ſibi tranſitum paret, an non. Cum Urinæ, ſaltem poſt diei intevallum, copioſiores & decolores ſenſim fieri incipiunt; tunc Aquam viam ſibi facere cæpiſſe puta. Nonnunquam primâ ſtatim die vel ſecundâ tertiâve, Alvus

ſolvitur, cum ejectione primùm fæculentioris ſaburræ, mox variegatorum humorum : hinc ſpes major affulget ; Febris enim, Alvo ſolutâ, ſenſim ſe remitti, atque ſymptomata ſedari incipiunt. Quod adeò verum eſt, ut ſi ſecundus vel tertius dies excurrat, abſque eo quod ventre ſecedant Ægri, etiamſi univerſa fortè Aquæ quantitas per Urinæ vias foras amandetur ; Clyſteribus tamen ſuppoſitis, & Oleo Amygdalarum dulcium per os aſſumto, lubrici reddendi : craſſiores enim humores, qui in primis viis continentur, quique Febrim fovent, vel in Febricitantium corporibus ex Morbo produci ſolent, haud poſſunt per cæca Urinæ ſecernicula foras protrudi, ſed per amplos Inteſtinorum tubos ſunt eliminandi. Adde, quòd exantlatis primis ductibus, facilè poterit Aqua in ultimos Corporis receſſus trajici, atque Sanguini, aliiſque ſecundariis dictis liquoribus medicinam facere.

Si verò accidat (accidit autem ſæpè) ut Parotides appareant, vel cum ipſis Alvi vel Urinæ excrementis purulentum quid intermiſtum obſervetur, quod evidens indicium eſt maturi & rupti jam Abſceſsûs ; haud ab Aquæ exhibitione ſurperſedendum, ſed eâdem urgendum magis eſt. Una enim Aqua, quæ ſtagnantes in internis partibus humores ad externas depellere, collectos ad maturationem perducere potuit, vim quoque habebit eoſdem per varia Corporis ſecernicula integrè deturbandi, atque partes Abſceſſu prehenſas à *necroſi* præſervandi : quemadmodum ſæpiſſimè in Praxi vidimus. Praxis tamen eadem nos docuit, abſceſſus in Cerebro & Thorace factos non adeò facilè Aquæ uſu ſuperatos eſſe : etſi non pauços vidimus, Pure è naribus, auribus, ore, & tuſſi quoque è pulmonibus educto,

integrè ſanatos. Solemus proinde cùm talium ſymptomatum ſigna ſuperveniunt, haud Aquæ præſidium reſpuere ; ſed ſi ſomnolenti evadant Ægri, Veſicantia, vel aliud Phænigmatum genus applicare : aut ſi difficultate ſpirandi exerceantur, Oleum ex Amygdalis dulcibus recens expreſſum propinare, vel Aquam ipſam ex frigidâ tepidiuſculam reddere. Non rarò inſuper accidit, ut primis præſertim Aqueæ diætæ diebus, vomitus, & quidem vehemens, ſuperveniat : quo ſi heterogenei humores, ut fieri ſolet, ejiciantur, pro bono habendum ; ceſſat enim cum Ægrotantis levamine, poſtquàm venticulus omninò exoneratus ſit. Quòd ſi Aqua ipſa vix epota evomatur, ad iteratas & frequentiores potationes Æger cogendus : etenim Aquam vomitu rejectam maligni humores ſubſequi ſolent. Conſtanter item & aſſiduò Aqua eſt exhibenda, ſi Singultns ſuboriatur : hunc enim quemadmodùm ab Aquâ excitatum, ita ab Aquâ continentur epotâ compeſci obſervamus. Sudor verò ſi Frigidam potanti ſuperveniat, ſolet vires exſolvere, non ſine magno vitæ diſcrimine : Id quidem paradoxon videri poterit iis, qui ex Frigidæ in Febribus potu ſudorem expectant, in quo *magnum* domini *Hancock Febrifugum* conſiſtere ſcimus. At in diætæ Aqueæ uſu, ſi ſudor ſuperveniat, is cohibendus, Aquâ adhuc frigidiori & copioſiori exhibitâ, Ægrique corpus remotis ſtragulis, ventilabro, & perflatu conclavis refrigerandum : ſunt qui & nive ipſâ contritâ conſpergere audent.

Maxima porrò in Aquæ uſu Medicorum crux eſt, cùm Ægri vel delirio, vel Lethargo, vel ſummâ virium abjectione affecti, ad Aquam juſtâ copiâ & frequentiâ bibendam impares redduntur. Tunc quidem

omnis

omnis adhibenda eſt induſtria, ut poſtremum quod illis reſtat remedium, nempe Aqua, exhibeatur : Quod à delirantibus vi & minis, à valdè debilibus & conſopitis Nive in os intrusâ, per fas & nefas, nonnunquam extorſimus.

Poſt expoſitam Aqueæ diætæ methodum, & quomodò ſymptomatibus ἐπιφαινόμενοις occurrendum ſit, reliquum eſt, ut quibus in Febribus, & quò illarum tempore ad hoc præſidium deveniendum ſit, exponamus. In principio ſanè Univerſali Febrium haud opportunum eſt ſtatim Aquam arripere : quum enim tunc temporis cruda & craſſa ſint omnia, haud jure ſperes à copiosâ Aquâ peccantes humores poſſe vel ſecerni vel exturbari. Secùs in Morbi ſtatu cùm omnia exacerbata ſunt, & ἡ νόσος ἀνθέει, ut ait *Hippocrates* cùm nempe Æger ad maximum periculum perductus eſt, Aquæ præſidium opportunum locum habet : tunc enim materia Febrim fovens ex diutinâ ebullitione, particularum contritionem quandam, vel, ſi mavis, aliqualem coctionis umbram adepta, poterit copioſæ Aquæ exhibitione, illiuſque cum humoribus corporis permiſtione veluti præcipitari, ſecerni, atque quâ data porta evacuari. Hinc igitur ſæpe accidiſſe vidimus, ut fortunatiùs evaſerint, qui in ipſo veluti mortis agone conſtituti ad hoc extremum præſidium, tanquam ad ſacram anchoram confugêre. Hoc monitum negligentes audaculi quidam Medici, Aquam in Febrium principio, vel incremento exhibentes, in maxima pericula, & mortem ipſam, Ægros deduxere. Non inficias tamen iverim, in Febribus Bilioſis, ſeu tenues humores pro cauſâ agnoſcentibus, non infelici auſu, Aquam quandoque in ipſo principio exhibitam eſſe : & ratio ex ſuprà dictis evidentiſſima eſt.

In Febribus igitur Acutis, Malignis, & lethalibus omnis generis, quo tempore opportunum videbitur, quod à maximo Ægri periculo ſignificare ſolet, ad diætam Aqueam deveniendum. Nam vel Febres tales ſunt, ex quibus ad concretionem tendit ſanguis ; & tunc Aquâ copiosâ cum eo permiſtâ facilè poterit fluidam naturam ferè amiſſam iterum recuperare : Vel ex Febre ſanguinis maſſa ad nimiam tenuitatem, cum ſpirituum exſolutione vergit ; atque hoc caſu Aqua, præſertim frigida, ſalia acria ſanguinem diſſolventia ſolvere & retundere potis erit. Unde phœnomeno lux, cur ſcilicet frigidum jam redditum Febricitantis Corpus ex frigidæ potatione veluti miraculo incaleſcat. Sive enim ſanguis ex pernicioſo ſpirituum effluxu concreſcere incipiat, ſive ex nimiâ illius diſſolutione ſpiritus evolent ; ſemper frigidæ copia cum illo permiſta (accedente quoque pororum cutis conſtrictione) æque ſpirituum diſſipationem prohibebit, adeoque Calor amiſſus revocabitur.

Hinc illud hic inculcandum, quod à principio inſinuavimus, Aquam non niſi nivatam Febricitantibus præſcribendam : primùm enim frigidâ ſe eâ copiâ ingurgitant Ægri, quæ operi neceſſaria eſt, calidam verò reſpuere poſt primas potationes ſolent : prætereà ab Aquæ frigiditate Ventriculi Fibris vis major elaſtica accedit, quâ propelli in ulteriores vias uſque ad ſanguinem ea facilè poſſit ; contrà tepeſcens fibras eaſdem ad atoniam diſponens, ſui mole ventriculum inflat, pondere premit ac anxium reddit.

Haud tamen diſſimulabimus, nos quandoque non frigidam, ſed calentem Aquam præſcribere : cùm ſcilicet Pulmonum & Viſcerum Inflammationes & dolores cum Febribus copulantur : veriti ne frigidum

partes

partes phlogoſi prehenſas ad πέκρωσιν diſponat. Verùm negare minimè poſſumus in his caſibus nonnunquam ad frigidiuſculam, etſi non nivatam, tranſitum fieri : cùm nempe, tepentis Aquæ faſtidio affecti Ægrotantes, illam aſſiduò bibere renuunt. Satius enim eſſe reputamus, multam frigidiuſculam, quàm paucam tepentem, ſed operi imparem miniſtrare.

Juxtà hos canones (quos Experimenta ſæpiùs inſtituta, & Ratio poſtmodùm, ſi non invicta, ſaltem non omninò infirma ſuaſit) Diætâ Aqueâ in Febribus multoties uſi, felices eventus notavimus, ut ἄριστον μὲν ὕδωρ verè fateremur. Nonnunquam tamen præconceptâ ſpe fruſtrati ſumus, quod à Medicinæ fortunâ, præſertim in magnorum Medicamentorum adminiſtratione, non abhorret : nil enim adeò certum in illâ eſt, quod fallere etiam accuratiſſimos Practicos ſæpè non poſſit.

Hucuſque de Frigidæ uſu in Febribus locuti ſumus : verumtamen ſunt & alii Morbi, in quibus Aqueam diætam, & non ſine Ægrorum emolumento, analogiſmo quodam ducti tentavimus. Tales ſunt Diarrhœa, Dyſenteria, imò & Cœliaca, & Lienterica affectio : tales ſunt Iſchuria Renalis & Dyſuria : tales Cardialgia & Cholera Morbus, Hypochondriaca & Hyſterica affectio : nec caremus exemplis Hydropis (quis credat ?) copiosâ Aquâ epotâ curati : reſeratis nempe cœcis Renum & Alvi viis è quibus & Aqua & ſeroſus latex ubertim effluxit. Imò & ſalutarem Aqueæ Diætæ uſum experti ſumus in Variolis, ſed in tertio illarum ſtadio, ad necem Ægris tendentibus, ex Abſceſſibus in cerebro & Pectore formatis : quo remedio

ingentem

ingentem puris copiam è naribus & ore excerni vidimus. Haud tamen in omnibus his Morbis Aqueam Diætam, hoc eſt, Aquam ſolam, omni interdicto Cibo, adhibemus ; ſed in Chronicis largâ frigidæ potatione quatuor horis ante parcum prandium, atque alterâ octo horis à prandio, contenti eſſe ſolemus.

Hæc quidem ſufficère putavi ad meum propoſitum : unum tamen poſtremò animadvertendum apprimè eſſe duco, quoad Aquæ frigidæ exhibendæ copiam ; gravius ſcilicet delinqui, ſi minori quantitate propinetur, quàm ſi excedenti. Quum enim eo fine Febricitantibus in valde ancipiti ſtatu conſtitutis Aqua exhibeatur, ut in omne Corpus diffuſa, meatus referet, liquoribus motum & tenuitatem naturalem impertiatur, ac membrorum omnium calorem roburque foveat ; id præſtituros. nos fruſtrà pollicebimur, modicam proxinantes Aquæ quantitatem, quæ in Ventriculo & primis Viſceribus moram trahens, tantum abeſt ut poſſit ulteriùs progredi, ut potiùs cum noxiis humoribus ibi ſtagnantibus permiſta, illorum putrefactionem promoveat, Ægroque perniciem moliatur. Opus igitur eſt, ut maximâ quantitate & ſucceſſivè ingeratur, ad hoc ut copiâ viam ſibi paret, & veluti alluvie Corpus univerſum inundet. Id autem eò audentiùs proſequendum, ſi poſt primam tranſactam diem, tranſitûs Aquæ ſigna per Urinam vel alvum apparuerint. Eô enim Aquam reliquis Remediis ſecuritate præſtare putamus, quòd tametſi nonnulla Medicamenta poſſent fortaſſè maximos Morbos debellare ſi excedenti doſi exhiberentur, veluti ſtibium Diaphoreticum, Bezoarticum, & ſal volatile

quodcumque

quodcumque, & ipſum Vinum generoſum copioſè epotum; verumtamen quis non videt, ex ipſâ excedenti doſi maximum vitæ periculum, debilibus præſertim Ægrotantibus, imminere? ſola Aqua innocentiſſima & tutiſſima videtur: vix enim Æger eſt adeò viribus deſtitutus, qui uberrimam Aquæ copiam ſuſtinere non valeat. Hinc haud παρὰ μήδοον factum puto, ſi etiam cùm deſperata res eſt, & jam conclamatum, Medicus facto prognoſtico, & expoſitâ quidlibet audendi occaſione, Aqueam Diætam, etſi contraindicatum remedium, ſi non præcipiat, ſaltem permittat: nonnunquam enim improviſis Naturæ. Modis, deſperatos jam Ægros ex inſperato ad ſalutem rediiſſe vidimus: ut pro ſano conſilio illud habendum ſit, ſatius eſſe anceps remedium experiri, quàm nullum.

Hæc ſunt quæ apud noſtrates de Aquæ in Morbis uſu experiri uſu venit, quo nullum familiarius per vulgi ora nunc fertur Ægritudinum omnium remedium: ut noſtris his temporibus aptari commodè poſſit Verſiculus, quem de *Euripide* à ventris cruciatibus, ope Clyſteris maris Aquà parati, liberato, refert *Laërtius*:

Ἡ θάλασσα κλύσῃ πάντα τῶν ἀνθρώπων. κακά

An ſimile accidere poſſit in frigidioribus Regionibus (de quo haud deſperem, nam etiam hybernâ tempeſtate tales per Frigidam Curationes hîc feliciter proſequimur) videant accuratiſſimi Viri, qui in Boreis Terræ plagis, non ſine maximâ laude & fortunâ faciunt Medicinam. Neapoli Calendis Januariis, Anno 1729. St. V.

NICOLAUS CYRILLUS in Reg. Univ. Neap. Prim. Med. Prof. & Reg. Soc. Leg. Socius.

V. *A ſhort Account of the different Kinds of* Ipecacuanha, *by Dr.* Douglaſs, *Med. Regin. Extr. & R. S. S.*

I beg Leave to take up a ſmall Part of this honourable Society's Time, in laying before them ſome Specimens of that celebrated vomiting Root, whether truly, or falſly called *Ipecacuanha*, which I keep in my Collection of the *Materia Medica*; together with a few Obſervations concerning their outward Appearance, by the Help of which the ſeveral Kinds thereof may be diſtinguiſhed from one another; and an Account of what I have hitherto been able to learn concerning the true Places of their Growth.

The firſt general Diviſion of theſe Roots muſt be, as has been already hinted, into true and falſe; and each of theſe may be again ſubdivided into ſeveral Species, the diſtinctive Note of which is principally taken from their Colour.

Of the true *Ipecacuanha* I have four Kinds, Black, Brown, Grey, and White; but I cannot pretend to determine whether they belong to different Plants, or are only Varieties of the ſame Plant owing to the Soil in which they grow, as is affirmed by our worthy and learned Preſident Sir *Hans Sloane* Baronet. And as theſe Roots are never imported to us entire, it is impoſſible to give any certain Deſcription of them in that State.

However, by comparing the ſeveral dried Pieces as we have them, we may very probably conjecture

that

that a ſhort radical Trunk deſcends from a *Cautis*, and is afterwards divided into ſeveral large Branches, and theſe again into ſmaller ones, in different Series, with minute Filaments or Fibrillæ going out from them.

Each Piece is made up of two general Parts, an Outer or Cortical, and an Inner or Fibrous, which like a white Nerve, or ſmooth compact Faſciculus of woody Filaments, runs through the Center or Axis of the Roots, and perhaps encloſes within it a ſmall Medulla or Pith, which however is hardly diſcernable by the naked Eye.

The Cortical Part is corrugated by two Sorts of Wrinkles, one ſuperficial, conſiſting either in circular Rings or little Knots which do not go quite round; the other penetrating into its Subſtance, being deep Inciſures or Fiſſures reaching all the Way to the Nerve.

What Lengths theſe Roots are of when taken out of the Ground, cannot be determined: I have met with ſome Pieces above nine Inches, many above ſix, but the greateſt Number are ſtill ſhorter.

We find them bent, wreathed, and contorted into all Manner of Figures; and indeed few Pieces are altogether ſtraight for any conſiderable Length.

What has been hitherto ſaid, agrees to all the true *Ipecacuanha-roots*; but ſeveral other Things are ſtill to be taken Notice of, in which they differ.

The Black Sort is the ſmalleſt of the four, very hard, and the Fiſſures wide and numerous. The outward Colour of the Cortex is not equally black in all the Pieces of this Kind, and its inner Subſtance, as well as the Nerve, is moſtly white, tho' not always in the ſame Degrees.

The Brown Sort is larger than the Black, the Fiſſures at larger Diſtances, the inner Subſtance of the Cortex darker, and the external Colour has ſeveral Degrees of Redneſs in the ſeveral Pieces.

The Third or Grey Sort is ſometimes found of a darker, ſometimes of a lighter Colour, and the Inner Subſtance of the Cortex is Brown ſtreaked with White. It is much larger than the black Sort, many Pieces being above a quarter of an Inch in Diameter, but the Nerve is ſmaller in Proportion to the cortical Part. I have met with few Pieces of this Species above five Inches in Length; but, as I already obſerved, nothing can be concluded from thence as to the Length of the whole Roots.

The Fiſſures are here ſtill fewer than in the brown Sort, and in ſome Pieces ſcarce any are to be met with. The ſuperficial Corrugations are various in different Roots, ſome being almoſt wholly ſmooth, and in others the Wrinkles rather longitudinal than circular.

The white Kind, as far as I can judge by the ſmall Sample which I have of it, is of very different Sizes, ſome Pieces of it being larger than any of the grey Sort, and the reſt much leſs. The whitiſh Colour of the Cortex is mixed with a yellowiſh Caſt, and the nervous Part is very large in Proportion to the reſt. Very few Fiſſures are to be obſerved therein, and hardly any reach ſo deep as the Nerve. The other Corrugations are likewiſe very ſhallow, and moſt of them longitudinal; but it ſeems to be more knotty than the other Kinds, and theſe Knots I take to be owing chiefly to the *Fibrillæ* which go out from the larger Branches of the Roots.

The

The *Loci Natales*, or true Places of Growth of theſe different Species of *Ipecacuanha* have not as yet been fully ſettled.

The Black Sort is hitherto known to come only from *Braſile*, whence we get it by the Way of *Liſbon*, and ſome of our Druggiſts for that Reaſon diſtinguiſh it by the Name of the *Braſile* Root.

About the Brown Sort, I am informed by Dr. *James Houſton*, who reſided for ſeveral Years in *New-ſpain*, that it grows plentifully at ſome Diſtance from the City of *Cartagena* in the Kingdom of *New Granada*; from whence it is frequently ſent in Saroons or Skins, containing 100 Weight, to *Jamaica*, and ſo to *England*; where it is certain we have had it of late Years in great Abundance.

The Grey *Ipecacuanha* is with us preferred to all the reſt, and by far the moſt generally uſed when it can be had. It is ſaid by Authors to grow in *Peru*, from whence we get it by the Way of *Spain*, it being brought from *Peru* to *Porto-Bello*, and from thence into *Europe*, by the *Spaniſh Galleons*. Some Parcels thereof are likewiſe probably ſent from *Porto-Bello* to *Jamaica*; for we are certain that it has ſometimes been imported hither from that Iſland. By ſome Specimens that were brought me by Mr. *Lightbody*, an ingenious Surgeon, from St. *Thomé*, a *Portugueſe* Iſland under the Equinoctial, whither they were ſent directly from *Braſile*, it is evident that this Species is likewiſe a Native of that Country, and therefore muſt either have been included by *Piſo* under one of the two Species mentioned by him, or elſe diſcovered ſince his Time. According to Father *La Bat*, in his late

Voyage to the Iſlands of *America*, this Species grows alſo plentifully in *Martinico*, where for many Years paſt it has been uſed by the Inhabitants.

The White Sort, called by the *Portugueſe*, *Ipecacuanha Blanca*, is ſaid by *Piſo* to grow in *Braſile*, and if we may believe Father *La Bat*, it is likewiſe found in *Martinico*.

Theſe are the four Kinds of true *Ipecacuanha* which have hitherto come to my Knowledge; but I have met with two other Roots to which that Name has been falſely aſcribed, which from their outward Colour I ſhall call White and Reddiſh Brown.

The White Sort agrees pretty much both in Colour and Surface with the true White, but it is not near ſo knotty. It is likewiſe conſiderably larger in Size, ſtraighter and ſofter to the Touch.

The Brown Sort is of a deeper Colour than the true Brown, and many Pieces thereof have ſome Mixture of Red (from whence it has been ſometimes called Red *Ipecacuanha*) and the inner Subſtance of the Cortex enclines to a reddiſh Yellow. The Pieces thereof are much longer than any of the former Sorts, ſome of them meaſuring ſixteen Inches, and they are of a Size between the Black and Grey. The Fiſſures are at greater Diſtances from one another than in the true Brown, and the Spaces between them much ſmoother. In a Word, though this Root when mixed with the true Brown, to which it bears the greateſt Reſemblance, may eaſily be confounded therewith; yet when they are attentively compared, their whole Appearance ſufficiently diſtinguiſhes them.

Both

Both theſe falſe Kinds were brought me from *Maryland* in 1725, by one M. *Seymour* a Surgeon, who informed me that they grow there in great Plenty, being called *Ipecacuanha* by the Inhabitants, and uſed as a Vomit by thoſe of inferior Rank. I have ſince that Time received a Sample of the Brown Sort, taken from a Parcel which lay in the Cuſtom-houſe, above twelve Years ago, and called by the Name of wild *Ipecacuanha*.

The forementioned Illuſtrious Sir *Hans Sloane* did me the Honour to inform me that this falſe Brown Kind was the ſame that was formerly ſent to him from *Virginia* for the true *Ipecacuanha*, and which he afterwards diſcovered to be the Root of a poiſonous Apocynum deſcribed by him in his *Natural Hiſtory of Jamaica*; in which Iſland it is very common, and likewiſe in *New-ſpain*, as appeared to him by the Specimens ſent him by his Correſpondent Dr. *Burnet*.

In his Introduction to the ſecond Volume of that excellent Hiſtory, he has obliged us with a very full and diſtinct Account of what he had learned from his Friends abroad, concerning the pernicious Effects of the ſeveral Parts of this Plant, and of the great Pains he was at to prevent its being brought into Uſe in this Country, which was then very much to be apprehended. *Helvetius*'s Name will always be mentioned with Honour for the great Share he had in rendering the Uſe of the true *Ipecacuanha* common in *Europe*; and I cannot think that Sir *Hans Sloane* deſerves a much leſs Degree of Praiſe for having detected this falſe Kind, which was inſenſibly creeping into Uſe,

the Effects whereof might otherwiſe have proved as fatal as the other is found to be beneficial.

I have only to add, that this poiſonous Kind of Apocynum is now cultivated by ſeveral curious Perſons about *London*, and that I deſign with all convenient Speed to preſent this Society with a particular Deſcription thereof, taken from a Plant which I had laſt Summer growing in my own Garden.

VI. *An Account of a Book entituled,* Heſperi & Phoſphori Nova Phœnomena, *&c. Auctore* Franciſco Blanchino; *by* John Hadley, *Eſq: R. S. V. Præſ.*

THE Deſign of this Treatiſe, is to give an Account of ſome new Aſtronomical Diſcoveries relating to the Planet *Venus*, which the Author diſpoſes under four Heads; *viz.*

1. The Deſcription of the dusky Spots obſerved in her Disk.
2. Her Rotation round an Axis, the Poſition of which is determined by the apparent Motion of thoſe Spots, together with the Time of her Revolution.
3. The Parallelifm of that Axis to it ſelf in all Parts of the Planets Orbit.
4. Obſervations in order to determine the Horizontal Parallax of *Venus*, and conſequently thoſe of the Sun and other Planets.

He takes Notice of five remarkable Spots in her whole Surface, the two ſmalleſt of which are placed, one near each Pole, the other three lie along the Æquator, and cover good Part of a Zone, extended to about 30 Deg. of Latitude on each Side. He repreſents them to be much like the larger dark Spots in the Moon, which are uſually called *Seas*, but conſiderably fainter, ſo as not to be eaſily diſcernable even to a ſharp-ſighted Obſerver, without the Aſſiſtance of a Teleſcope, capable of repreſenting diſtinctly the Planet under an Angle equal at leaſt to that under which the Moon appears to the naked Eye, and with an Aperture of 3 or 4 Inches of the *Roman* Palm. He then proceeds to give the Deſcription of a Machine contrived by him to repreſent to the Sight the Motion of the Earth and *Venus* in their Orbits, and by the Means of a Lamp placed in the Center, to ſhew the Phaſes of the Planet, and Appearance of the Curve Lines deſcribed by the Revolutions of the Spots round the Axis.

This Revolution he makes greatly different from thoſe of the Earth and *Mars* (the two Bodies next in order of the Planetary Syſtem) both in the Poſition of the Axis and Time of the Period. He places the *Colurus Solſtitiorum*, or Plane, paſſing through the Axis of the Planet and Tropical Points of its Orbit, about the 20th Degree of *Leo* and *Aquarius*, and gives the Planes of its Æquator and Ecliptick an Inclination to each other of about 75 Degrees. He determines the Time of the Revolution to be about 24 Days and 8 Hours, inſtead of 23 Hours, as it has been generally taken to be from ſome Obſervations made by Mr. *Caſſini* in

the

the Years 1666 and 1667, but which he himſelf did not ſeem much to rely on. Now, both theſe Periods may be very conſiſtent with the ſame Obſervations, provided that one of the Obſervers did not continue his Obſervations for any conſiderable Time at once. For if the exact Situation of any Spot be obſerved at any given Hour one Day, and at the ſame Hour the ſucceeding Day be found advanced about 15 Degrees or $\frac{1}{24}$ of the whole Revolution, it may ſtill remain doubtful, whether the Spot has moved only thro' thoſe 15 Deg. in that Day, or has made one or more entire Revolutions beſides in that Time. This the Author was aware of, and therefore waited for an Opportunity of attending to the Motion of a Spot as long at once as the Vicinity of *Venus* to the Sun would admit of. Accordingly, *Feb.* 26, 1726, a little after Sunſet, he obſerved a Spot near the Center of her Disk, where their Motion is moſt perceptible in a ſhort Time, and about 3 Hours after, perceived the ſame Spot not ſenſibly removed; from which he concluded, the Period of its Revolution could not be ſo ſhort as one Day, ſince, if it were ſo, the Change of Place of the Spot muſt have been very ſenſible in that Time. It were to be wiſhed the Author had had Opportunities of confirming this Period by more Obſervations, eſpecially ſince it was neceſſary to begin them ſoon after Sunſet, and continue them till *Venus* was near the Horizon; the Strength of the Twilight in the firſt Caſe, and the Thickneſs of the Atmoſphere through which the Planet muſt be ſeen in the latter, rendring the Obſervations very difficult.

The

The next Article of his Obſervations, is the Continuance of the Axis in the ſame Paralleliſm, through the whole Orbit of the Planet. This is ſo neceſſary and obvious a Conſequence of the eſtabliſhed Laws of Motion, that there needs no more to be ſaid about it.

The 4th Article contains an Account of ſome Obſervations made to determine the Parallax of *Venus* in the Year 1716: The Method he uſed for this Purpoſe, was to take the ſeveral Diſtances of Time between the Appulſe of the Limb of *Venus* and of *Regulus* (which Star ſhe paſs'd by about that Time) to a horary Circle very near the Meridian, and to another about 6 Hours after, which he meaſured by the Pulſes of a Watch, of which 143 went to 1 firſt Minute of Time. He likewiſe obſerved the Alteration of thoſe Diſtances taken at the ſame Hour ſeveral Days one after another, and allowing a proportional Alteration for the Time between the two Obſervations, he computed what the Difference of their right Aſcenſion ought to have been in the latter of them, if there were no Parallax; then comparing this Difference with that obſerved, he concluded the Diſagreement to be the Parallax of right Aſcenſion. This Method the Author ſeems to depend on ſo much, as to think that an equal Degree of Exactneſs is hardly to be expected from any other hitherto practiſed: But if we conſider that the whole Parallax of right Aſcenſion amounts by his Obſervations to no more than 4 Pulſes of his Watch, and that he allows a Poſſibility of an Error of near one of thoſe Pulſes in taking each of the Tranſits, it is evident that if ſuch an Error be actually committed in each of the Obſervations on which the finding of the Parallax depends, and all of them hap-

pen to conſpire the ſame Way, the Reſult of all together may poſſibly be greater than the whole Parallax found. Upon the whole, he makes the Horizontal Parallax of *Venus* at that Time to have been 24″ 20‴, and that of the Sun 14″ 18‴; but as he takes no Notice of the Latitude of the Place in deducing the Horizontal Parallax from that of right Aſcenſion, they both ought to be encreaſed on that Account by about $\frac{1}{7}$, or in Proportion of 3 to 4. If therefore there be no other Miſtake in his Numbers, the Horizontal Parallax of the Sun, as deduced from his Obſervations, ſhould be about 19″.

He concludes with giving ſome Cautions to thoſe who may attempt hereafter to repeat theſe Obſervations, both in Regard to the Time proper for it, and the Choice and Conſtitution of the Teleſcope to be made uſe of. For greater Eaſe of the Obſerver, there is at the End a double Table, containing the Heliocentric and Geocentric Motions of *Venus* for eight Years; after which Space of Time, the Earth and *Venus* return very nearly to the ſame Situation. In this Table he ſays are marked the moſt convenient Times for obſerving; but theſe Marks, by ſome Overſight, are omitted in the Table.

For a Teleſcope of 100 *Roman* Palms he allows an Aperture of 3 or 4 Inches of that Palm, with an Eye-glaſs whoſe focal Length may be from 7 to 11 of the ſame, but what he directs in longer Inſtruments to increaſe the Breadth of the Aperture and focal Length of the Eye-glaſs in the ſame Proportion with the Inſtrument, muſt certainly be the Effect of ſome Miſtake: For in this Caſe, a longer Teleſcope will magnify no more than the ſhorter, but only have the

Strength of Light in the Object encreased in Proportion to the Square of the Length.

At the End of the Treatise is subjoined a Letter from the Reverend Father *Melchior à Briga*, &c. to the Author, giving an Account of some former Attempts to discover the Revolution of this Planet round its Axis, by Mr. *Cassini*, *De la Hire*, &c. consisting chiefly of an Extract of a Letter from Mr. *Cassini* to Mr. *Petit*, printed in the *Journal des Sçavans*, 1667, Tom. ii. Edit. *Amst.* The 2d and 3d Figures which are referred to in this Letter, are inverted by the Engraver, who copied them from the Original.

VII. *Observations on a Treatise wrote by Monf.* Helvetius *of* Paris, *designed to prove that the Lungs do not divide and exspand the Blood, but that on the contrary, they cool and condense it.* By F. Nicholls, *M. B. Præl. Anat.* Oxon & *F. R. S.*

THE Matter in Question between the Author and Signior *Michellotti* is, whether the Lungs cool and condense the Blood, according to the Opinion of the Antients, or whether they mix, attenuate, and of Consequence expand it, according to the System of Dr. *Pitcairn.*

The Author, in order to ſupport the Opinion of the Antients, brings ſeveral Arguments to confute the Syſtem of Dr. *Pitcairn:* The moſt conſiderable of which (and which indeed he makes his *Argumentum crucis*) is, that the right Auricle and Ventricle being conſiderably larger than the left Auricle and Ventricle, and the pulmonary Artery having a larger Capacity than all the pulmonary Veins taken together, the Blood muſt evidently occupy a greater Space before than after its Paſſage thro' the Lungs; and becauſe the Difference in the Capacity of theſe Veſſels cannot be ballanced by any Increaſe of the Velocity, he concludes, that the Blood is not attenuated and expanded, but muſt be condenſed in its Paſſage through the Lungs. And this the Author conceives is done by the Air, which (as a Fluid relatively cold) muſt cool and condenſe the Blood, to which it is ſo nearly applied in the Action of Inſpiration.

Had the Author of this Treatiſe been contented with ſupporting the Opinion of the Antients, without endeavouring to ſubvert the Syſtem of Dr. *Pitcairn*, he would probably have found many Advocates for his Doctrine, and few Oppoſers.

That the Blood is cooled by the Action of Inſpiration, is a Matter of which I believe few Phyſicians doubt, when they conſider that in Inflammations of the Lungs, nothing is more earneſtly deſired than the breathing cool and freſh Air, nor does any thing more evidently conduce to the Cure of theſe and other Inflammatory Diſpoſitions, than the Uſe of freſh Air. But that this is the ſole Uſe of breathing, or that this cooling Power can over-balance the Expanſion from the Action of Expiration, is what I can no ways conceive.

If

If we conſider the State of the Blood at its Return to the Heart, and how careful Nature has been, not to uſe this Blood for the Nouriſhment of the Lungs before it has paſſed through the pulmonary Vein and Artery (though it would in that Caſe have been as effectually cooled in the Bronchial Arteries as in the pulmonary Veſſels) we are naturally led to believe, that it is ſome other Quality which has rendred it improper for Nouriſhment, and which is to be deſtroyed by the Action of the Lungs.

I have before allowed, that it ſeems almoſt evident that the Blood is cooled, and of Conſequence condenſed in the Action of Inſpiration; but for the Reaſon mentioned, and from conſidering the Structure of the Parts ſubſervient to breathing, it ſeems equally true, that the Blood is mixed, attenuated, and conſequently re-expanded in the Action of Expiration. I ſhall now conſider whether the Action of Inſpiration ſo far overbalances the Action of Exſpiration, as to condenſe the Blood into a leſs Bulk than it had before its Paſſage through the Lungs.

The accurate *Santorini* of *Venice*, in the 8th Chapter and 3d Section of his Obſervations, has carefully examined the Fact as ſtated by Monſ. *Helvetius*; and finding it true in that one Subject, as to the Auricles and pulmonary Veſſels, but falſe as to the Ventricles, he proceeds to prove that this Difference in the Capacity of the pulmonary Veſſels, could not be deſigned on Account of the Blood's being condenſed in its Paſſage through the Lungs; becauſe, if ſo, the right Ventricle ought to have been larger than the left Ventricle; and the pulmonary Artery ought, not only to have been larger than the pulmonary Veins,

but

but it ought likewiſe to have been larger than, or at leaſt equal to, the two *Venæ Cavæ*; whereas in his Subject, the two *Venæ Cavæ* were to the pulmonary Artery, as 228 to 188.

In the mean time, he recommends the repeating the Enquiry to other Anatomiſts, as doubting whether the Fact is conſtantly ſo in healthy Subjects. *Ut cæteri diligentiores Anatomici diſquirant utrum ea firma & perpetua ſint? an in corporibus integris.*

As ſuch an Enquiry may be of Conſequence, not only in ſettling the Point in Queſtion, but in explaining other Parts of the Animal Œconomy, I doubt not but it will be agreeable to the Society; and the rather, becauſe the Subjects from which I have taken the ſeveral Calculations, are here produced before the Society, and ſubmitted to a Re-examination, if deſired.

The Meaſure which I have here uſed is the 113th Part of an Inch.

I have taken the Triple of the Diameter for the Periphery, and computed the *Area* by multiplying the neareſt whole Number to $\frac{1}{4}$ of the Diameter into the Periphery. Though this Method is not ſufficiently exact to ſhew the real Contents of Circles, yet as my Deſign here, was only to find nearly the relative Contents of the ſeveral Veſſels, I have choſe to avoid embaraſſing the Sums with Fractions.

The

The first Heart is of an Adult in which

The *Diam. Per.* & *Areas* are

Of the Vena Cava descendens	79	237	4740		4901
Pulmonary Artery	115	345	10005		10386
Superior left pulm. Vein	69	207	3519		3739
Inferior left pulm. Vein	73	219	3942		4185
Superior right pulm. Vein	49	147	1764	12477	1886
Middle right pulm. Vein	40	120	1200		1256
Inferior right pulm. Vein	57	171	2052		2551
Aorta	110	330	8910		9503

The ascending Cava being tied above the Diaphragm, could not be measured in this Subject.

As Monsr. *Helvetius* no ways mentions the Disease of which the Subject died from whom he took his Observation, so I cannot say how proper it was for such an Examination; but it is evident, his Observation does not tally with the Calculations made from this first Heart; where the pulmonary Artery is to the Sum of all the pulmonary Veins as 10005 to 12477. And yet this Subject (besides a cancerated Ovary, and a Putrefaction of the right Kidney from the Ureter's being compressed) had her Lungs full of small Tubercles, and the Glands lying between the great Divisions of the *Trachæa* almost petrified by atheromatous Concretions: By all which it is highly probable, that the Passage of the Blood through the Lungs was very much impeded, and of Consequence, the pulmonary Artery much dilated beyond its natural Capacity.

And this I am the rather induced to believe from examining the second Heart, which is of a Child nearly twelve Months old. As to its Death, I can say nothing

nothing more, than that its Lungs appeared perfectly ſound, and of a pale clear Colour; and therefore the more proper for an Examination of this Kind.

In this ſecond Heart the *Diam. Per.* & *Areas* are,

Of the Aorta above the Coronaries	43	129	1419	
Pulmonary Artery	43	129	1419	
Superior left pulm. Vein	29	87	609	2088
Inferior left pulm. Vein				
Superior right pulm. Vein	26	78	507	
Middle right pulm. Vein	17	51	204	
Inferior right pulm. Vein	32	96	768	

We may here obſerve that the Aorta, after giving off the Coronary Veſſels, is equal to the pulmonary Artery. As to the Proportion between the pulmonary Artery and Veins, the Artery in this Subject is to the Sum of all the Veins here meaſured, as 1419 to 2088, and yet the lower left pulmonary Vein is here omitted, as being tied too cloſe to admit of being meaſured. But if we ſuppoſe the inferior left pulmonary Vein to be to the ſuperior left pulmonary Vein in the ſame Proportion as in the firſt Heart, we ſhall then find its Diameter nearly 31, and its Area at leaſt 700, which will make the pulmonary Artery in this Heart, to the Sum of all the pulmonary Veins as 1419 to 2788; and in that Caſe, the left pulmonary Veins will be to the right pulmonary Veins, but as 1309 to 1479.

The

The 3d Heart is of an Abortive nearly of 5 Months: By its Appearance, I judged it ſuffocated by too much Blood.

Of the	In this Subject the	*Diam.*	*Per.*	*Areas* are,	
	Vena Cava deſcendens	14	42	197	629
	Vena Cava aſcendens	24	72	432	
	Aorta above the Coronaries	16	48	192	
	Pulmonary Artery	20	60	300	
	Canalis Arterioſus	12	36	108	
	Right pulmonary Branch	11	33	99	198
	Left pulmonary Branch	11	33	99	
	Superior left pulm. Vein	11	33	99	294
	Inferior left pulm. Vein	9	27	54	
	Superior right pulm. Vein	7	21	42	
	Middle right pulm. Vein	11	33	99	

The inferior right pulmonary Vein is here cut too cloſe, and otherways injured, ſo that its Area cannot be meaſured. Nevertheleſs we find the remaining pulmonary Veins to the pulmonary Branches of the pulmonary Artery, as 294 to 198.

We may here obſerve a remarkable Difference between the Capacities of the two *Venæ Cavæ* taken together, and the pulmonary Artery; the two *Cavæ* being more than Double the pulmonary Artery, and the pulmonary Artery ſtill one Third larger than the Aorta. As this Difference could not ariſe in this Caſe from the Blood's being condenſed by the inſpired Air, ſo it ſeems a Proof, that had the Fact been true, as ſtated by Monſ. *Helvetius*, it had nevertheleſs been an inſufficient Demonſtration of his Syſtem.

VIII. *Obſervationes Diverſæ Lunaris deliquii die 2 Februarii, A. D. 1728.*

Obſervatio Lunaris Deliquii in Coll. Societ. JESU Romæ, *A. C.* 1729, *die* 2 Februarii *tempore p. m. vero. Communicante Rev.* J. Bapt. Carbone, *R. S. S.*

		H.	′	″
INitium Eclipſis		7h	44′	22″
Immerſiones		H.	′	″
Grimaldi		7	46	16
Kepleri			48	8
Coper-nici	Initium		54	20
	Medium		54	46
	Finis		55	10
Ty-chonis	Initium	8	11	57
	Medium		13	7
	Finis		13	48
Manilii			19	0
Menelai			20	50
Dioniſii			23	0
Plinii			25	44
Maris tran-quillitatis	Medii		31	6
	Totius		33	1
Procli	Initium		34	41
	Finis		35	29
Maris Criſi-um	Initium		36	1
	Finis		39	44
Lunæ totalis Immerſio			43	17

		H.	′	″
Emerſiones		H.	′	″
Primi Limbi Lunaris		10	21	38
Ricciolii			23	37
Gri-maldi	Initium		24	7
	Finis		25	4
Ariſ-tarchi	Initium		34	39
	Finis		36	8
Ty-chonis	Initium		41	11
	Finis		42	5
Heli-conis	Initium		47	10
	Finis		48	14
Pato-nis	Initium		54	33
	Finis		54	57
Ariſtotelis			57	54
Menelai		11	2	5
Maris Se-renitatis	Medium		4	33
	Finis		9	15
Poſſidonii			10	36
Cleomedis			14	7
Maris Criſi-um	Medii		16	20
	Totius		17	36

Finis Eclipſis 11h 20′ 41″

Eodem

Eodem die distantia meridiana Centri solaris a vertice non correcta per Refractionem observata est 55° 9′ 31″ in Gnomone, cujus meridianam Ellipsis solaris in pavimentum projecta pertransiit tempore 2′ 15″ & diameter apparens solis micrometri partes 2945 intercepit, quarum Luna paulò ante Eclipsim observata intercepit 2903.

Observationes habitæ sunt Tubo optico pedum Romanorum $8\frac{1}{4}$.

Lunare Deliquium Parisiis observatum Eodem Die 1729. *Communicatum ab* Eodem.

H.	′	″	p. m.
7	1	0	Penumbra densa
7	3	0	Penumbra densissima.
7	3	¾	Eclipsis initium ex aliis phasibus deductum.
7	8	50	Galilæus obtegitur.
	14	0	Umbra ad Aristarchum.
	15	4	Aristarchus totus in umbra.
	16	44	Keplerus obtegitur totus.
	18	4	Umbra ad Gassendum.
	19	20	Sckicardus tectus omninò.
	22	0	Umbra ad Reinoldum.
	22	40	Ad limbum Copernici.
	23	43	Erathostenes obtectus.
	25	15	Copernicus totus in umbra.
	27	2	Helicon totus.
	31	50	Umbra ad limbum Tychonis.
	33	8	Tycho dimidius in umbra.
	33	30	Ad limbum præcedentem Platonis.
	33	47	Plato in umbra totus.
	38	7	Ad præcedentem limbum Manilii.
	39	20	Manilius totus.

H.	′	″	
7	41	45	Umbra pervenit ad Menelaum.
	42	35	Ad Menelai dimidium.
	45	22	Ad Plinium.
	49	47	Ad præcedentem Fracaſtorii limbum.
	50	30	Ad Promontorium acutum.
	51	24	Umbra tegit Fracaſtorium.
	54	30	Pertingit ad Proclum.
	55	16	Proclum tegit totum.
	56	17	Ad limbum maris Caſpii.
	58	56	Ad dimidium.
	59	0	Ad limbum Caſpii ſequentem.
8	2	0	Finis dubius.
	3	0	Finis certus.
9	41	18	Emerſionis initium.
	41	33	Grimaldus incipit.
	45	40	Grimaldus emergit totus.
	49	35	Galilæus.
	51	30	Sckicardus.
	54	34	Capuanus.
	55	16	Ariſtarchus incipit.
	56	5	Totus extra Umbram.
	58	35	Keplerus totus.
10	0	30	Primus Tychonis limbus.
	1	30	Dimidius Tychon extra umbram.
	2	30	Emergit totus.
	3	40	Lasbergius & Reinoldus.
	5	19	Incipit Copernicus.
	6	43	Copernicus totus.
	7	33	Emergit Erathoſtenes.
	8	0	Totus Helicon.
12	56		Plato incipit.

41 15

H.	′	″	
10	14	15	Totus extra Umbram.
	20	35	Manilius incipit.
	21	28	Totus emergit.
	23	50	Menelaus.
	27	25	Plinius.
	30	19	Dionyſius.
	31	0	Promontorium acutum.
	36	15	Proclus.
	37	26	Incipit Mare Caſpium.
	41	24	Finis dubius.
	42	0	Finis certus.

Obſervatio paucarum, quæ ferme omnes trans nubes tenues conſpectæ ſunt, Phaſium Defectus Lunæ, habita (tubo optico optimæ notæ, longo pedes Pariſienſes ſeptem) Patavii. *Idibus Febru. Anno a R. S.* 1729. *à Cl.* J. Poleno *Aſtr.* Patav. *& R. S. S.*

Temp. Appar.

H.	′	″	
p.	m.		Obſervationem Initii Defectus nubes denſæ impedivere.
7	44	40	Umbra attingit Grimaldum.
7	45	40	Grimaldum tegit totum.
7	50	53	Attingit Mare Humorum.
7	53	26	Tegit Maris Humorum dimidiam partem.
8	19	34	Tegit Menelaum.
8	38	10	Cooperit totum Mare Criſium.

Per

9 26	Per dehiſcentes nubes Luna admodum rubicunda obſervari poterat perſpicue adeo, ut non meminerim aliàs in totali immerſione tam clare Lunam apparuiſſe; quod ita fortaſſe viſum eſt ob atram obſcuritatem, quam circumpoſitæ denſæ nubes efficiebant.
10 15 6	Umbra dilui incipit è regione proximæ emerſionis.
10 26 45	Grimaldus, jam emerſus, ab umbra diſtat tota fere ſua tranſverſa diametro.
10 31 40	Dimidium Mare Humorum diſcoopertum.
10 38 45	Tycho totus emergit.
10 50 12	Apparet Eratoſtenes.
11 13 27	Promontorium Somnii totum diſcoopertum.
11 19 45	Luna inſici videtur ſola penumbra.
11 20 56	Finis etiam penumbræ.

IX. *Obſervationes quædam Eclipſeos Lunaris Die* 29 Julii *habitæ A. D.* 1729.

Obſervatio Eclipſis Lunæ totalis, A. 1729 *mane d.* 9. Auguſti *Stil.* Nov. *habita* Witebergæ Saxonum, à Jo. Friderico Weidlero *L. L. D & Math. Prof. Ordinar. Communicante* Hans Sloane *Baronetto R. S. Præſ.*

	H.	′	″
INitium ſub Grimaldo. Mane d. 9 Aug. temp: Europ.	0	1	30

Umbra

		H.	′	″
Umbra tangit Galileum		0	3	45
Umbra tangit Aristarchum		0	6	0
Umbra tangit Keplerum		0	11	0
Postea nubes condunt lunam.				
Tegitur mare Crisium dimidium		0	54	0
M. Crisium totum		0	57	0
Immersio totalis		1	1	0
Emersio		2	40	30
Emergere incipit Galileus		2	43	30
Emergere incipit Aristarchus		2	45	0
Emergere incipit Keplerus		2	49	0
Emergere incipit Copernicus		2	54	45
Emergere incipit Plato		2	55	30
Emergere incipit Timocharis		3	1	30
Emergere incipit Manilius		3	4	0
Emergit totus Tycho		3	8	30
Emergere incipit Menelaus		3	10	30
Emergere incipit Plinius		3	13	0
Emergere incipit Cleomedes		3	18	0
M. Crisium & una M. Nectaris		3	23	30
M. Nectaris totum emergit		3	29	0
M. Crisium totum emergit		3	31	30
Incipit emergere Langrenus		3	34	30
Finis		3	40	0

Exeunte umbra inter Langrenum & Petavium.

Obser-

Observatio Defectus Lunæ habita (tubo optico, longo pedes Parisienses sex) Patavii *ab Cl.* J. Poleno *R. S. S. Die* 29 Julii 1729. *S. V.*

Temp. Appar. H.	′	″	
0	0	28	Initium umbræ ad Lunæ Limbum.
	13	55	Umbra tangit Copernicum.
	15	49	Hunc totum tegit.
	22	24	Attingit Tychonem.
	24	14	Totum Tychonem cooperit.
	28	40	Attingit Manilium.
	30	15	Hunc totum cooperit.
	33	2	Menelaum tangit.
	34	22	Menelaum omnino cooperit.
	49	10	Attingit Mare Crisium.
	54	56	Mare Crisium totum cooperit.
	58	48	Totalis Immersio.
2	37	38	Lux in Lunæ margine.
	41	20	Grimaldus extra umbram.
3	4	15	Mare Serenitatis emergere cœpit.
	6	16	Tycho totus emergit.
	7	28	Manilius totus discoopertus.
	10	30	Menelaus extra umbram.
	13	58	Mare Serenitatis totum emersit.
	21	48	Promontorium Somnii jam extra umbram.
	23	10	Mare Crisium incipit emergere.
	25	28	Totum Mare Nectaris extra umbram, & dimidium Mare Crisium.
	29	0	Mare Crisium integrum apparet.
	33	20	Langrenius extra umbram.
	38	8	Finis Emersionis ab omni etiam penumbra.

F I N I S.

Numb. 411.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *October*, *November* and *December*, 1729.

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I. *A Letter to* Sir Hans Sloane, *Bart.* R. S. Præs. *containing a Geographical Deſcription and Map of the Kingdom of* Tunis, *with a Poſtſcript relating to the Cure of* Intermittent Fevers *in thoſe Parts*; *By the Reverend Mr.* Tho. Shaw, *Chaplain to the* Engliſh *Factory at* Algier.

II. *A brief Account of ſome of the Effects and Properties of Damps, in a Letter to* William Rutty, *M. D. R. S. Secr. from Mr.* Iſaac Greenwood, *Profeſſor of Mathematicks at* Cambridge, New England.

III. *A*

The CONTENTS.

III. *A Letter from the King's Officers at* Sheerneſs *and* Chatham, *to the Honourable the Commiſſioners of the* Navy, *giving an Account of what they met with in opening an antient Well near* Queenborough *in* Kent, *communicated by Mr.* Peter Colliſon, *F. R. S. on* January 8, 1729.

IV. *Some Obſervations on the* Crane, *with Improvements on that Machine, by* J. T. Deſaguliers, *F. R. S. Shewn the Society in Models, but here exemplified by Figures.*

V. *Of the* Meteor *called the* Ignis Fatuus, *from Obſervations made in* England, *by the Reverend Mr.* W. Derham, *F. R. S. and others in* Italy, *communicated by Sir* Tho. Dereham, *Bart. F. R. S.*

VI. *Duæ Obſervationes Eclipſis Lunæ Totalis Nocte ſequente Diem* 28 Julij 1729. *S. V. Communicante Cl.* Thomâ Dereham, *Bart. & R. S. S.*

Jos: Banks

I. *A Let-*

Phils. Trans N.o 411
Tab. I.

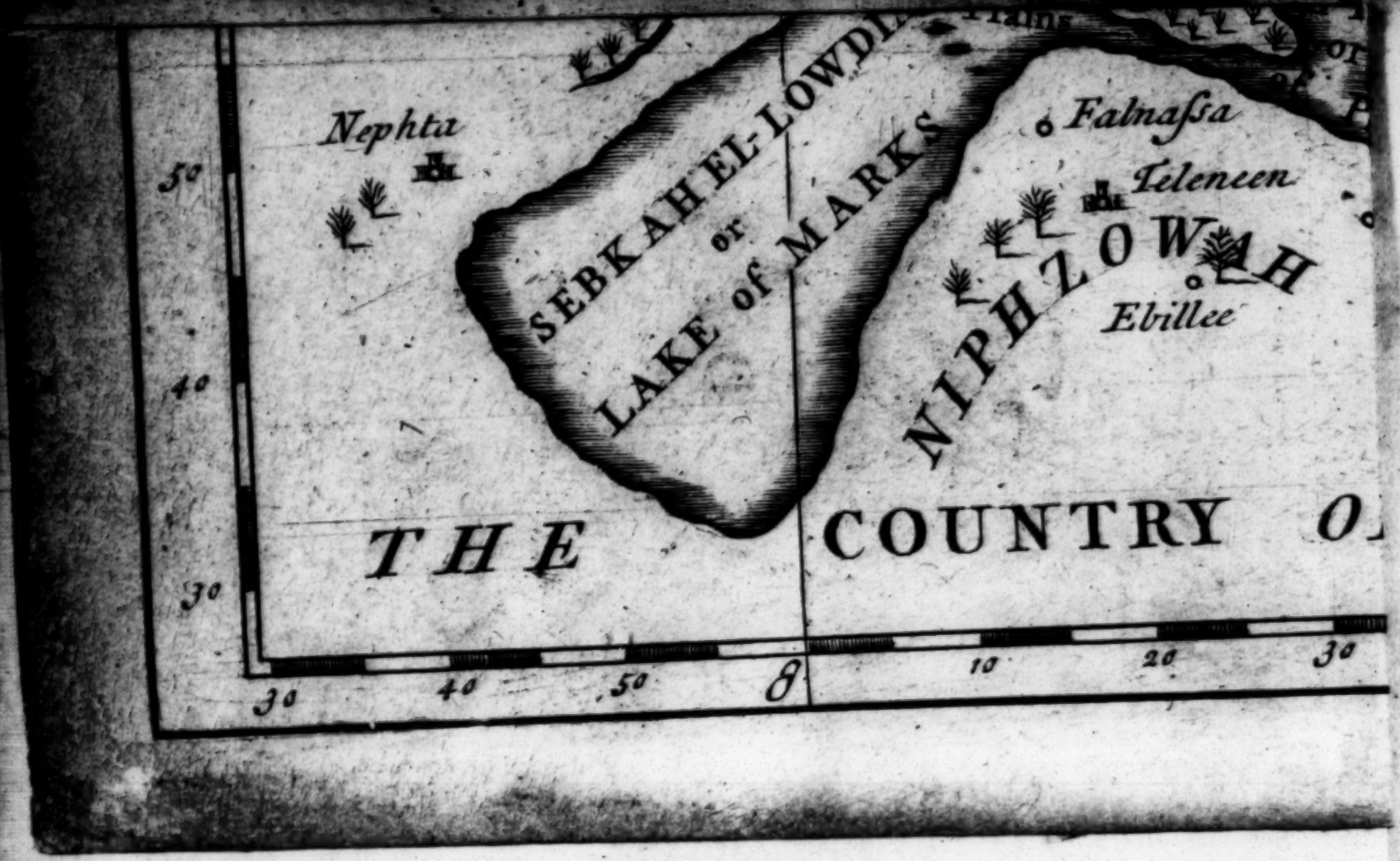
KINGDOM of TUNIS

To the Honourable
Sr. Hans Sloane Bart. President of
the Royal Society &c. this Map of the
KINGDOM of TUNIS
is with all Respect dedicated
by his most obedient
and humble Servant
Thomas Shaw

Algier July 7th 1729

FRE-GEA

Cape Negro
Cape Serra
Cape Blanco
Biserta
The Dogs
Thimida
Elalich
Cape Zibeeb
Bona
I. Tabarca
Bastion
Lolatte
Matterr
Bowstatter
Fort Farina
Fallah
Lowramoor
Cape Bonne
C. Cammart
Lowkaria
Sede Dowd
C. Carthage
Bardo
Goletta
Tunis
Gurbos
Rhados
Clibea
Suburbo
Beja
R. Beja
Plains of Busdera
Bagradas
Tagaste
or
Mezerilbah
Selowkia
Tunga
Tubersoke
R. Mallat
Lorbos
Dugga
Musti
Mesherga
Bomsha
Yellah
Mt. Keran
Tubemoke
Gurba
Aseit
Gerado
Nabal
Mamamett
Aqueduct
Mt. Lowan
Zungar
Seloome
Gulph of HAMAM-METT
Casir Mahalowle
Casir Howley
Hereda
Useph
Hydra
Mansorus
Nabhana
Mt. Usulett
Sbeeba
Tibesa
R. Hatsiab
Kisser
Gelowlah
Mt. Megala
Mt. Trusza
Cairwan
R. Megaleel
R. Deflilah
Tusana
Spetula
Sussyeen
Zelephia
Gilma
Susa
Sahaleel
Monastier
Lempta
Bowhadgar
I. Gowry
Tobulba
Demas
Arregis
Elmadia
Saleeto
Gabras
Gemm
Elalia
Sbea
Shebba
Rugga
Capowdia
Buttra
Gebiniana
Inshilla
Querquennes
Stax
Tarsowa
R. Jarki
Tarney
Mahares
Unga
Feriana
Gassa
Gorbata
ALGIER
ELSARA or the DESERT
SA-HUL
BLAIDE EL GEREED
OR
LESSER SYRTIS
THE COUNTRY OF DATES
Sbekka
Elham'a
Tegense
Sede Medhub
Ellamett
R. Acrowd
Tosser
Bahira
Plain
el Pharaoon
or
of Pharaoh
Nephta
Fatnassa
Teleneen
Maggs
Ebillee
SEBKAH-EL-LOWDIA
or
LAKE of MARKS
NIPHZOWAH
Elham'a
Woodrist
Gaps
R. Inlan
Tobulba
I. Serba


Nephta
SEBKAH EL-LOWDI
or
LAKE of MARKS
Falnassa
Teleneen
NIPHZOWAH
Ebillee
THE
COUNTRY O
50
40
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40
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I. *A Letter to* Sir Hans Sloane, *Bart.* R. S. Præſ. *containing a Geographical Deſcription and Map of the Kingdom of* Tunis, *with a Poſtſcript relating to the Cure of* Intermittent Fevers *in thoſe Parts; By the Reverend Mr.* Tho. Shaw, *Chaplain to the* Engliſh *Factory at* Algier.

SIR, Algier, July 9. 1729.

THIS waits upon you with a Map of the Kingdom of *Tunis*, which I have very faithfully laid down, according to the Obſervations I lately made in thoſe Parts. From *Tunis* I travelled as far Weſtward as *Hydra*, and from thence went to *Toſer*, paſſing from *Tegewſe* through the *Lake of Marks*, or the *Palus Tritonia*, as I take it, to *Gaps*; from *Gaps* I travelled all the Way upon the Coaſt to *Biſerta*; but at the ſame Time took Care to viſit ſuch Places within Land, where I could learn of any Ruins or Curioſities. I made uſe of a ſmall, but very good Mariners Compaſs, and found the Variation at *Cairwan* 10 Degr. Weſt; at *Biſerta* ſomething more than 12 Degr., and at *Algier* I find it now to be 30 Degr. 30 Min. I carried along with me likewiſe a Braſs Quadrant of a Foot Radius, and took the Latitudes of *Tunis*, *Cairwan*, *Spetula*, *Gaffſa*, *Toſer*, *Ebillee*, *Gaps*, *Stax*, *Suſa*, *Lowharia* and *Biſerta*, with all the Exactneſs ſuch an Inſtrument would admit of. As to the Longitude, moſt Mariners whom I have converſed with, agree within 10 or 12 Miles, that the Diſtance between *Algier* and the *Guletta* (or Port of *Tunis*) is 400 Miles. I have

made this Voyage four Times, and the Reckonings we made aboard, amounted only to 390. I have made therefore the Meridional Diſtance betwixt this Place and Cape *Carthage* 350 Miles: (allowing 48 to a Degree of Longitude) for as this whole Courſe is not upon the ſame Parallel, we may very well allow 40 or 50 Miles for the oblique Sailing; becauſe the Courſe is in 37 Degr. 20 Min. N. Lat. but *Algier* lies in 36 Degr. 48 Min. and the *Guletta* in 36 Degr. 40 Min.

The Civil War which unfortunately broke out in this Kingdom (*i.e.* of *Tunis*) when I was preparing to return by Land to *Algier*, diſappointed me of ſeeing ſome few Places to the Weſtward, and of continuing my Voyage through *Theveſte*, *Lambeſa*, *Cirta*, *Sitifi*, *&c.* to *Algier*. But I intend, God willing, to take theſe in my Way to *Italy*, and ſhall then loſe no Time or Opportunity of making what further Diſcoveries I can in thoſe Parts, and of laying before you the Geography and Antiquities of the *Mauritania Cæſarienſis* and *Sitifenſis*; of the *Numidia* betwixt the Rivers *Ampſaga* and *Tuſca*; as well as of the *Africa propria* of *Pliny*, and the *Bizacium* of *Strabo* and *Ptolemy*, which I am now going to give you ſome Account of.

The Kingdom of *Tunis* is bounded to the North and Eaſt with the *Mediterranean Sea*, to the Weſt with the Kingdom of *Algier*, and to the South with that of *Tripoly*. It is 230 Miles in Length from the Iſle of *Gerba*, in Latitude 33 Degr. 24 Min., to Cape *Serra*, in Latitude 37 Degr. 16 Min. and 128 Miles in its greateſt Breadth from *Monaſteer* to *Tibéſa*. *Sbeka*, its utmoſt Boundary to the Weſt,

West, lies in Longitude 7 Degr. 26 Min. and *Clybea*, its utmoſt Boundary to the Eaſt, in 10 Degr. 47 Min. from *London*.

Of the modern Geographers, *Luyts* ſeems to have been the beſt acquainted with its Extent in general, giving it 3 Degr. of Longitude, and (above) 4 Degr. in Latitude. The *Sanſons* place it above 3 Degr. further to the South than it ſhould be, and their Error is greater, in relation to the Longitude. *Moll* places it a few Minutes only too far to the North, but to the South he has extended it beyond the Parallel of *Tripoly*, wherein I find he has been followed by Mr. *De Liſle*, in his Map of *Africa*, 1722. But a long Chain of Mountains which run in the ſame Parallel of Latitude with *Gerba*, are the Limits of *Tunis* and *Tripoly*.

If we take the Antients for our Guides, we ſhall ſtill find further Errors and Diſagreements. For *Ptolemy* makes the Difference of Latitude betwixt *Carthage* and *Gaps*, almoſt the two Extremities of the Kingdom, to be only 1 Degr. and 50 Min. (provided the *Italian* Copy I make uſe of be correct) The like Diſtance he puts between *Gaps* and *Toſer*, making thereby the latter 110 Miles more to the South; whereas I found it 18 Miles more to the North. Thus again he places *Gaſſa* in Latitude 29 Degr. 45 Min. and *Gaps* in 30 Degr. 30 Min. making *Gaps* a great Way to the North; whereas the Courſe from *Gaſſa* to *Gaps*, is near 80 Miles South-Eaſt: not to ſpeak of his placing *Carthage*, and ſo reſpectively of other Places, too far to the South by near 4 Degr. 30 Min. or 270 Miles. The like Errors may be obſerved as to his Difference of

Longitude of particular Places, and as to his Scale of Longitude in General, which he places at leaſt 10 Degr. too far to the Eaſt.

The *Antinine* Itinerary will alſo admit of ſeveral Doubts and Contradictions, as *Ricciolus* has already obſerved, *Geogr. p.* 74, and therefore is not to be altogether depended upon; though it muſt ſtill be allowed to be a much better Conductor than *Ptolemy*. Thus the Author of the *Itinerary* makes it to be 216 Miles from *Suffetula*, I preſume by the Way of *Adrumettum*, to *Clypea*, thereby making *Clypea* 111 Miles from *Adrumettum*; whereas in another Place, in his *Maritime Itinerary*, he only makes a Difference of about 44 Miles, or 350 Furlongs. And again he makes the direct Road from *Carthage* through *Laribus* and *Theveſte* to *Cirta*, to be 332 Miles; but the Road by *Hippo Regius*, or *Bona*, which ſhould be further, only 312. So that great Caution is to be obſerved in following that Authority.

Pliny is not ſo particular as either *Ptolemy* or the *Itinerary*. He lays down Things in general, and therefore can give but little Light and Aſſiſtance to a Traveller, in pointing out to him the antient Boundaries, or the particular Cities of this Kingdom. His Alphabetical Collection of Towns, has but little Inſtruction in it, and where he would ſeem to follow ſome Order and Method, as in naming the Towns along the Coaſt of *Bizacium*, he places *Adrumettum* and *Ruſpina* after *Leptis*; thereby inſinuating, as if *Leptis* lay at a greater Diſtance from the leſſer *Syrtis*; the contrary to which is proved eaſily from *Hirtius* and other Authors. And if with *Cluverius*,

rius, &c. we ſhould make the *Africa* of *Pliny*, comprehending even the two Provinces of *Zeugitana* and *Bizacium*, to be the Kingdom of *Tunis*, we ſhall meet with great Difficulties in the Geography, eſpecially of *Bizacium*, which is the Southern, and ought to be the greater Part of it. For as *Pliny* makes it only 250 Miles in Circuit, and to extend from *Adrumettum* or *Hercla* North to *Sabrata*, or to *Gaps* only, or *Tacape* South, we ſhall find that this Number of Miles will not be ſufficient to meaſure the Coaſt twice over, and therefore can lay no Claim at all to any Part of the Continent. But how far ſhort ſoever this Calculation may be of the Truth, it ſeems very probable, that the Province of *Hadrumettum*, as deſcribed by *Ptolemy*, how faulty ſoever he may be in Particulars, is the *Bizacium* which we look after, and that it included the *Blaide el Gereed*, or *Country of Dates*, which *Pliny* and the Author of the *Itinerary* ſeem to have known nothing of, or not to have regarded. For *Ptolemy*'s *Uſulitanum*, *Turza*, *Zugara*, Cities ſtill preſerving their old Names, and near upon the ſame Latitude with *Adrumettum*, continue to remain its Boundaries to the North; as *Toſer* and *Gaps*, the *Tiſuro* and *Capi*, or *Tacape* of the Antients, do to the South; while *Tæney* and *Gaffſa*, or the antient *Thæne* and *Capſa*, determine the Midland Continent. And in this Situation, * *Strabo* ſeems to place his *Bizacii*; and at the ſame Time makes the Country of the *Carthaginians* to be only the *Zeugitana* of *Pliny*,

* Supra Syrtes *Pſyllos* atque *Naſamones* atque *Getulorum* aliquos: deinde *Syrtas* & *Byzacios* uſque ad Carthaginienſem regionem: ea enim eſt multa. *Strab. Geogr. l.* 2.

contrary

contrary to the Opinion of ſome Geographers, who give it a much greater Extent. However the *Zeugitana*, or the greater Part of it at leaſt, is ſtill called *Fregēa* or *Frikæa* by the *Arabs*; and as this is without doubt a Corruption of its antient Name, ſo the Tradition of it through ſo many Ages, may perhaps be a ſtronger Argument, that this was the *Africa* properly ſo called of *Pliny*, or the Province of *Africa*, by Way of Eminence, than moſt of the Geographical Reaſons which have hitherto appeared to the Contrary.

The Kingdom of *Tunis* then contains the *Africa propria* of *Pliny*, with the *Bizacium* of *Strabo*, or the Province of *Hadrumettum* of *Ptolemy*, to which we are likewiſe to add ſo much of *Numidia* as lies half a Day's Journey, or ſix Leagues Weſt of *Keff*; for *Keff* or *Sicca Venerea* is now Part of theſe Dominions, and which *Ptolemy* and *Pliny* place in *Numidia*, though it is almoſt in the ſame Meridian with the River *Tuſca*. I am with all Reſpect, Sir,

Your moſt obedient and humble Servant,

Tho. Shaw.

POSTSCRIPT.

SIR, July 15.

BY a Letter juſt received, I am adviſed, that moſt Parts of *England* have ſuffered very much this Year by Intermitting Fevers; and as we have a Species of the *Scabioſa* here, which is of great

great Virtue in removing that Diſtemper, I thought proper to ſend you a Specimen of its upper Leaves, for the lower are at preſent dried up. It is not unlike the Figure which *Moriſon* gives of his 20th Species, Cap. XXI. Sect. 6. Tab. 14, or of his 25th Species, Cap. XXI. Sect. 6. Tab. 15. of Corymbiferous Plants, only the Head is not round, as there deſcribed. I have therefore preſumed to call it, *Scabioſa, flore pallide purpureo, capitulo oblongo, foliis ſuperioribus inciſis, inferioribus integris, ſerratis.* The Method of preparing it is to put a Handful of it into a Quart of Water, and boil it away to a Pint. A Coffee-Diſh full of this Decoction is given Faſting, a little before Dinner, and at Night, to the Patient, no Regard being had to the Interval or Intermiſſion of the Fit, as in giving the Bark; and it operates ordinarily by Stool or Urine. I have only ſeen this Plant *here*, at *Oran*, *Gibraltar*, and Mount *Libanus*, where I firſt was acquainted with its extraordinary Qualities. If it is not known in *England*, though I think Mr. *Bobart* ſhewed me it at *Oxford*, pleaſe to adviſe me, and I ſhall ſend you a Quantity of it dried, and the Seed of it, from this Place. There are other Herbs here made uſe of in different Diſtempers, and oftentimes with Succeſs, and which I ſhall give you an Account of in the Natural Hiſtory of this Country; but none is in ſo much Vogue and Eſteem, as the Herb I have now deſcribed to you. How far its Virtues may be altered, diminiſhed, or entirely loſt in another Climate, Experience alone can teach us; only I can aſſure you, that in this, the Uſe of it for a few Days has been known to re-

move the moſt inveterate Caſes. I am with all Reſpect, Sir,

Your moſt obedient and humble Servant,

Tho. Shaw.

II. *A brief Account of ſome of the Effects and Properties of Damps, in a Letter to* William Rutty, *M. D. R. S. Secr. from Mr.* Iſaac Greenwood, *Profeſſor of Mathematicks at* Cambridge, New England.

SIR,

YOUR obliging Letter I received not till about Half a Year after the Date thereof; and have been lead on to ſo long and criminal a Delay of my Anſwer, in Hopes of procuring ſomething that might be worthy of your Notice.

I have now ſent you incloſed, a brief Account of two Inſtances of the deadly Effect of vitiated Air upon Animal Life.

If ſuch Experiments as I have made on the Damp therein mentioned, be of any Importance in the Diſcovery of the true Cauſe of this wonderful *Phænomenon*, I ſhall have attained my End. I take the Liberty to write my ſelf,

Your moſt obedient humble Servant,

Cambridge, New England, Howard Colledge, May 10. 1729.

Iſaac Greenwood.

Mr.

Boſton, July 19. 1729.

MR. *Adams* and his Servant being employed to repair a Pump in this Place, about ſix o' Clock this Afternoon uncovered the Well; upon which he immediately attempted to go down, by Means only of a ſingle Rope; but had not deſcended above five or ſix Feet, before he was rendered uncapable of ſuſtaining his Weight, and without ſpeaking, or any Signals of Diſtreſs, ſlipped down ſuddenly to the upper Part of the Joint of the Pump; where being ſupported about a Minute, fetching his Breath in a very diſtreſs'd Manner, he fell to the Bottom, which was about eight or ten Feet lower, and covered with but a very few Inches of Water, without diſcovering any Signs of Life. Hereupon his Servant *(Thomas Reardon)* with great Precipitation took the Rope in his Hand, in order to deſcend to the Relief of his Maſter; but at the ſame Diſtance from the Top, met with the ſame fatal Interruption; and without diſcovering any Signs of Diſtreſs, was heard to fall to the Bottom.

The Workmen above prepared a *Third* with a Tackle about his Waſte. Upon his Deſcent he was rendered Speechleſs, and made no Signs at all, though he had agreed to it; whereupon being raiſed from the Well, he was found to have the Image of Death impreſs'd upon him; but upon the Uſe of proper Means was ſoon recovered, without remembring any thing particularly that had paſſed.

Some Hours after this the other Bodies were taken up; but, as we had before been well aſſured

it would be, with all the Marks of a violent Death upon them.

There was nothing particular relating to this Well, excepting that it was nearly ſituated to the Town-Dock, the *Reſervoir* of all the Dregs of the Neighbouring Streets; and is about 30 Feet deep, which in this Place is ſo conſiderable, that it is lower than the Surface of the Water at the greateſt Ebb. There had not been an *Air-Tube*, or Paſſage for the external Air to communicate with it for ſome conſiderable Time.

This Evening ſeveral Trials were made on *deſcending Lights*; particularly, by letting down *lighted Candles* uncovered, others incloſed in Lanthorns, and others with the Lanthorn placed in a Pail; but in all theſe Endeavours it was obſerved, that whatſoever the Circumſtances of the deſcending Light were, it never reach'd above ſix Feet.

July 20. I repeated this Evening ſuch Experiments in the *Damp* as related to *Flame*, and found the Effect much the ſame as before; *viz.* in about 6 Feet below the Top of the Well, the Flame would grow dim, and if not immediately raiſed, would change to a bluiſh Colour, and become more and more contracted or diminiſhed, till in about a Minute's Time it would be totally extinguiſhed, without any Remains or Stench accompanying the Wick. In theſe Experiments I particularly obſerved, that the *Flame* in all its Changes ſtill continued its Pyramidical Figure; nor did a quicker or ſlower Deſcent make any Alteration in theſe Circumſtances. One Experiment was very particular, relating to the Flame of a Candle.

dle. We took a common Pail, and having fix'd a Candle to the Bottom thereof, erect, about 8 Inches long, we poured as much hot Water into the Pail as reach'd within a quarter of an Inch of the Blaze of the Candle. Then having carefully lowered the Pail down the Well, the Flame, notwithſtanding it was defended by the reeking Steams of the hot Water, went out at the ſame Depth, and in the ſame Time as it did before. After this we immers'd burning Coals, flaming Brimſtone, and lighted Matches, all which were extinguiſhed with very little Difference as to the Time, or other Circumſtances.

Two Experiments were made relating to *Animal Life*. A large *Kitling* was very much affected in about a Minute's Time; and after 3 Minutes was rendred ſo weak, that after ſhe was taken out, ſhe could not ſuſtain her Weight on her Legs. Being at length pretty well recovered, we carefully bound her up in a Silk Handkerchief, that ſhe might be the more eaſily ſuſpended; and having let her down about 16 or 18 Feet, in three Minutes ſhe was affected in the like Manner as before, making a very diſtreſs'd Noiſe, and in about five Minutes was in ſuch extraordinary Convulſions as rendered the Sight not a little diſagreeable; but in theſe Throws ſhe diſengaged herſelf from the Handkerchief, falling to the Bottom, without making any Efforts to ſwim; whence we concluded they were the laſt Struggles for Life, in which ſhe broke looſe.

We tried the ſame fatal Experiment upon a ſmall Bird, which being ſuſpended in the *Damp* about three Minutes, was found entirely ſenſeleſs, and ac-

cording to all Appearance paſt Recovery. Upon taking it in my Hand, I found it was very cold, nor had it the leaſt Motion that I could diſcover; however, keeping of it cloſe between my Hands, which were pretty warm, in about a Minute I felt a ſmall Palpitation, which preſently increaſed to a ſtronger Pulſe, till in about ſix or ſeven Minutes the Bird was reſtored to a perfect and uninterrupted Reſpiration. About half an Hour after this, we again put the Bird into the *Damp*, and continued it there about five Minutes, after which we found it paſt Recovery.

July 21. I repeated ſeveral of the Experiments relating to Lights and Flame, which ſucceeded with very little, if any Alteration, as before; which we looked upon as an undoubted Confirmation of the Continuance of the *Damp*. Whereupon we proceeded; firſt, to examine the Elaſticity of the Air in the Well, by letting down a ſmall Bell, the Sound of which was as diſtinct and loud, as in any ordinary Well of the ſame Depth.

Then to diſcover the Degree of Moiſture, we took a large Spunge a little wet, which with the *Silk String*, whereby we let it down, weigh'd 278 Grains. This being ſuſpended in the *Damp*, upwards of five Minutes, and then raiſed, was carefully weigh'd, and found to be of the ſame Weight preciſely. After this we dried the *Spunge*, which then weigh'd but 261 Grains, and having applied it to the *Damp* for the Space of ten Minutes, we found alſo, that it had not gained the leaſt Part that could be perceived in its Weight. Alſo, a large Bundle of *Cat-*

gut,

gut, weighing two Ounces fifteen Penny-weight ten Grains, acquired not the leaſt Augmentation thereto, by being ſuſpended for a very conſiderable Time.

To theſe Experiments we added one upon the *Hydroſtatical Ballance*, in order to determine whether there was any extraordinary Difference as to the Denſity, or Specifick Gravity of common, and this *vitiated Air*. The *Ballance* we made uſe of was very large, and accurately poiz'd, and the *Solid*, which was a Globe, was four Inches eight tenths in Diameter. This with its String weigh'd in the Air ſeven Ounces ſix Penny-weight. And after we had immers'd it in the *Damp*, it loſt nothing of its Weight, being then *in Æquilibrio* to ſo great a Degree of Exactneſs, that half a Grain would over-ponderate on either Side.

This *Damp* abated more and more by being expoſed to the Air, till on *July* the 25th, Perſons were let down to the Bottom without any Inconvenience.

The other Inſtance is of a very ſudden Subterraneous Vapour, on *May* 9, 1729, in a Well in *School-houſe-Street*, *Boſton*.

This Well had been opened for ſome conſiderable Time; and not only enlarged in its Diameter, but ſunk fourteen or fifteen Feet deeper. Hereupon Mr. *Rennief*, and a young Man whoſe Name was *Ruſſel*, undertook to lay the Stones. They had been employ'd all the Day, till about ſix o'Clock in the Afternoon, when *Rennief* perceived a very unuſual Stench, of which he firſt upbraided his Partner as an Act of Indecency, till by the extraordinary

Increaſe

Increaſe thereof, he was apprehenſive of ſome greater Danger. *Ruſſel* was hitherto unſenſible thereof, but perceiving his Partner's Viſage to change to a very uncommon Degree, call'd up for Relief; at which Inſtant, as he afterwards expreſſed himſelf, *He firſt perceived a very ſtrong noiſome Smell, reſembling rotten Fiſh, which on a ſudden ſeized his Senſes, and rendered him unable to ſuſtain his Weight.* *Rennief* had immediately cloſed his Mouth and Noſtrils with his Hand; and when the Bucket was lowered with a *third* Perſon for their Relief, aſſiſted in getting *Ruſſel* into it. As the Bucket was raiſing, *Ruſſel* was taken with very unuſual and extraordinary Fits; and when he was laid upon the Ground, till *Rennief* was taken out, could ſcarce be kept ſtill by the united Strength of three or four Perſons; but bounding and writhing his Body, like a Fiſh newly taken from the Water. *Rennief* was affected only with fainting Fits. After three Hours *Ruſſel* recovered of theſe extraordinary Convulſions, but was diſordered in his Brain during the whole Night; and though *Rennief* was ſooner relieved of his Fits, he continued extreamly diſordered for a longer Time. It was thought remarkable, that neither of them was affected with either Vomiting or Purging.

This Accident happened on *Friday*, and on the *Monday* they were both reſtored to perfect Health. The Well continued infected for a very little while, and when on the *Monday* following ſome other *Workmen* renewed the Work, there was nothing Noiſome that could be perceived.

I can-

I cannot call to Mind, that there is any Inſtance of ſuch a tranſient Vapour or Damp recorded in the *Royal Tranſactions*; and muſt confeſs I am at a Loſs how to account for it. Should there be Subterraneous Exhalations which, like the Clouds or Wind in the Atmoſphere, ſhifted from one Place to another, it might be of great Importance to obſerve the Particulars thereof, eſpecially ſuch as are *Malignant*, as this was. The Paſſage of this Vapour was about 25 Feet below the Surface; a Depth too great for it to affect Cellars or Vaults.

I had forgot to note, that this Part of the Town lies very high; and the Ground for about ten Feet, hard Clay, and the reſt a coarſe Sand and Gravel.

III. *A Letter from the King's Officers at* Sheerneſs *and* Chatham, *to the Honourable the Commiſſioners of the* Navy, *giving an Account of what they met with in opening an antient Well near* Queenborough *in* Kent, *communicated by Mr.* Peter Colliſon, *F. R. S. on* January 8, 1729.

Chatham-Dock, Octob. 9. 1723.

Right Honourable,

IN Obedience to your Honours Warrant of the 16th of *September* laſt, we met at the Well near *Queenborough*, where the Caſtle formerly ſtood, on *Tueſday* the 24th *ditto*, and finding but very little Water

ter at the Bottom on our Sounding, and it having a new Curb, lately fix'd on the Top, we provided our ſelves with Buckets and Ropes, and lower'd down a Man, who acquainted us, that it was clean'd, and the Ground ſunk four Feet deeper than the Curb at the Bottom. We then meaſur'd the Depth of it, and found it 200 Foot, and artificially ſteen'd the whole Depth with circular *Portland* Stone, which is all entire, and ſtands fair, the mean Diameter is four Foot eight Inches; but obſerving, that not one Drop of Water came into it, we reſolved to try whether we could find any by Boring; in order thereunto, we applied ourſelves to make the neceſſary Preparations, by getting a Piece of Timber of about ſeven Foot long, and boring it through with a three Inch and a half Auger, which Trunk we fix'd at the Bottom of the Well, and faſten'd it by Quarters to the Curb at the Bottom, to prevent its raiſing, and fill'd it all round three Foot deep with Clay, and on that laid four Courſe of Bricks for a Platform for the Men to ſtand on in their boring, and got alſo an Auger of two Inches and half, to bore through the Clay, but could not get all the neceſſary Appurtenances till *Thurſday* the 26th of *September*, when three Men at a Time began to bore, whom we ſhifted every three Hours; the Boring which they ſent us up, was a very cloſe bluiſh Clay, which continuing the ſame after three Days and a half boring, we began to deſpair meeting with Water; but on *Monday* the 30th of *September*, in the Evening, as they were boring, the Auger ſlipt down at once, and up came Water, to our great Satisfaction; and in

an

an Hour's Time there was upward of four Foot Water, which roſe ſo faſt, that at twelve o' Clock at Noon,

	Feet.	Inch.
On the firſt of *October*, we found - -	55.	10
On the 2d, at 5 in the Afternoon, - - -	109	08
On the 3d, at 3 in the Afternoon, - -	132	06
On the 4th, at 3 in the Afternoon, - -	149	06
On the 5th, at 4 in the Afternoon, - -	161	03
On the 6th, at 10½ in the Morning, - -	167	08
On the 7th, at 4 in the Afternoon, - -	174	00
On the 8th, at 7 in the Morning, - - -	176	07

and ſtill increaſes, though ſlowly. The Reaſon of its not riſing ſo much now as at firſt, we apprehended proceeded from the Weight of Water which the Spring through the Hole of the Trunk muſt force up, and the Well being wider aloft than below. What we think very extraordinary is, that we bored 81 Feet below the Foot of the Trunk before we met with this Body of Water, which by Computation is 166 Feet below the deepeſt Place in the adjacent Seas. The Water proves excellent good, ſoft, ſweet and fine; we compar'd it with the beſt Spring Water brought from *Milton*, and in every Body's Opinion that taſted both, they declar'd the Well-Water the beſt. We put ſome Soap to it, and it Larther'd finely; we boil'd old Peaſe in it, which performed very well, and we have great Reaſon to believe, that the Spring will ſufficiently ſupply his Majeſty's Ships, as propoſed.

Signed by

Richard Froſt, James Young, Edmond Oxley, Benj. Roſwell, Richard Stacey, J. Hayward,

John Ward, William Hogg, J. Dod, Charles Finch, D. Devert, William Jones,
King's Officers at *Sheerneſs* and *Chatham.*

IV. *Some Obſervations on the* Crane, *with Improvements on that Machine, by* J. T. Deſaguliers, *F. R. S. Shewn the Society in Models, but here exemplified by Figures.*

THE Crane is an Inſtrument ſo much uſed, and ſo well known, that it wou'd be needleſs here to give a particular Deſcription of it; but as there are ſeveral Sorts of Cranes, and as that Machine is to ſerve for different Purpoſes, I wou'd only ſhew what kind of Crane is moſt proper for any particular Work; and how to prevent thoſe Accidents which daily happen through the Careleſneſs of common Labourers, to the damaging of Goods, and often the wounding, or killing of the Men.

When great Weights are to be rais'd from a great Depth, and laid on Carriages very near the Precipice, as at the Edge of a Stone Quarry, the Crane muſt be a fix'd one, and only the Gibbet moveable, from which the Weight hangs, as in *Fig.* 1. Here, in the common Way, the Rope R r *r*, or Chain, which runs over the Gibbet, goes between two Pullies P, Q, fixed within the upper horizontal Beam of the Crane A Q T X, above the Axis of the Gibbet B G V, ſo as to be carried eaſily to the Right or Left Hand, from W to *w*, when the Gibbet turns upon its Axis to bring the Burthen over the Carriage deſign'd to re-

ceive

ceive it. For this Purpoſe, a ſmall Rope, call'd the Guide-Rope, is faſten'd to the Weight, or to the upper Part of the Gibbet near its Extremity, g, which a Man is to pull to bring the Weight over the Place, to which it muſt be lower'd. Now in performing this, the main Rope or Chain not continuing parallel to the Arm of the Gibbet, gives the Weight a Tendency towards that Side to which it deviates, and that ſometimes ſo ſuddenly, that without Care, and much Force applied, if the Weight be very great, the Burthen will ſwing to or from the Carriage, ſo as to break every thing in its Way. Sometimes an horizontal Piece, like an Handſpike, is fix'd in the upright Shaft of the Gibbet a little above B, to turn it by; but in that Caſe too the Force is unequal, as the Weight is carried round; ſo that the Lives of the Men that are Loading, often depend upon the Care of the Man who guides the Weight, by either of the Means above-mentioned.

N. B. No Situation of the Pullies can prevent this; and we find Accidents to happen every Day, as will appear by the Examination of *Fig.* 3.

But if upon the Axis of the Gibbet there be fix'd an Iron Wheel, *y*, with many Teeth, to be carried round by a Pinion, *u*, of a few Leaves, upon the End of whoſe Axis is faſten'd a Wheel, *x*, with Arms (that Axis going through the perpendicular Piece T Z behind the Shaft of the Gibbet) a Man ſtanding at that Wheel is out of Harm's Way, and has ſuch an Advantage of Power as to hold the Weight ſteady in any Place requir'd, notwithſtanding its Tendency to ſwing, as mention'd above, which is not felt at the Ends of the Arms of this laſt Wheel.

The firſt who has made Uſe of this Contrivance is Mr. *Ralph Allen*, Poſt-maſter of *Bath*, at his Stone-Quarry, where the Weight rais'd is 4 or 5, and ſometimes 6 or 7 Ton.

I need not ſay that the Power to bring up the Weight works here by Means of a Capſtane, or upright Shaft, R O, drawn round by Horſes, that the Weight may come up more expeditiouſly, though in the Figure the Handſpikes, *f*, *e*, *b*, going in at ſuch an Hole as *d*, ſhew that Men may work it upon Occaſion.

The ſame Gentleman. having laid his Stone on Waggons of a peculiar Make, cauſes it to run down Hill about a Mile and an half, on a wooden Waggon-way (which I ſhall hereafter deſcribe with the Waggons, when I ſhew the Society the Models, which are now making) to the River-ſide, where he has a Wharf, and there by another Crane exactly ſuited to the Work, he takes the Stone from the Carriages, and with great Expedition lets it down into the Barges or Veſſels that come to fetch it.

In deſcribing this Crane of Mr. *Allen*'s, I ſhall ſhew how Accidents are prevented in this Manner of working.

This Crane is of the Sort which is commonly call'd a *Rat's Tail Crane*, Fig. 7. moving round a ſtrong Poſt like a Wind-mill, ſo that it may turn quite round with all its Load. The Axel B b, on which the Rope winds, is here horizontal like a Winch; but to gain Strength, inſtead of the walking Wheel C A, it is carried round by a ſtrong Wheel and Pinion, *Fig.* 5 and 6; or is in Effect a double Axis in Peritrochio. Now in the common Cranes of this Kind,

there

there is only a Catch (as EKA, *Fig.* 5.) to hold the Burthen at the Height it is brought up to, whilſt the Crane is turn'd round in order to have the Weight lower'd into the Veſſels, which is done by lifting up the Catch, and being ready to let it down again as Need requires. Sometimes an half Circumference of Wood (DIIB, *Fig.* 5.) is held hard againſt a wooden Wheel W *w*, on the Axel, to regulate and govern the Deſcent of the Weight. But as in either of theſe Caſes, if the Man at the Crane is careleſs, very bad Accidents happen, Mr. *Padmore*, Mr. *Allen*'s chief Work-man, has made ſuch a Contrivance, that the Pall or Lever whereby the Axel is preſs'd to direct the deſcending Motion, does ſo communicate with the Catch, that in Caſe the Man that ought to manage it, ſhou'd careleſly let it go, the Catch always takes, and thereby all Accidents are prevented; as will be ſhewn in the Explanation of the 5th and 6th Figures.

Where Goods are to be rais'd high, as in unloading Veſſels, and alſo to be let down deep, as in loading them; (that is, where both the former Operations are to be perform'd) if the Weights do not exceed two or three Ton, and many Hands are not to be had, then an endleſs Screw turn'd by an Handle at each End (in an oppoſite Situation, or with one Handle and a Balance to it) leading an Axis in Peritrochio, or as it is commonly call'd, a Worm and Wheel applied to a Crane, with a Gibbet, is moſt uſeful: For the Teeth of the Wheel are pull'd by the Weight ſo directly againſt the Thread of the Worm in its Endeavour to deſcend, that one may leave the Handle in any Poſition where it will ſtop, without

out any Catch, or the leaſt Danger of the Weight falling back again.

But then, if you wou'd have the Weight to be let down, to deſcend pretty quick, which cannot be perform'd by applying the Hand to the Handle, which goes through a great Space in Compariſon to the Space deſcrib'd by the Weight (without which ſufficient Force would be wanting) only give the Handle a Swing, and if the Worm be well oil'd, the Handle and its Counterpoiſe, or the two Handles, will perform the Office of a Fly in the common Jack, turning very faſt round, and regulating the Motion of the Weight, which from that Impulſe will deſcend continually, and not too faſt, like the Weight of a Jack.

The Way to ſtop this Motion at any Time, is to graſp the Axis of the Screw hard, betwixt the Screw and the Handle in its round Part. The Hand is ſufficient to do it, and will ſtop it in two or three Turns.

N. B. *Such a Crane may be ſeen at Mr.* Gray's, *who makes them to ſell, at* Mill-Bank, Weſtminſter.

The worſt Cranes are thoſe where Men walk in a large Wheel, by reaſon of Accidents that happen daily on account of the ſhort Space between a Man's two Feet. This may be prevented by uſing four footed Animals, the Length of whoſe Bodies makes a Baſe of ſufficient Length to keep the Wheel from running back, *Fig.* 7.

An

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Tab. II

Fig. 1.

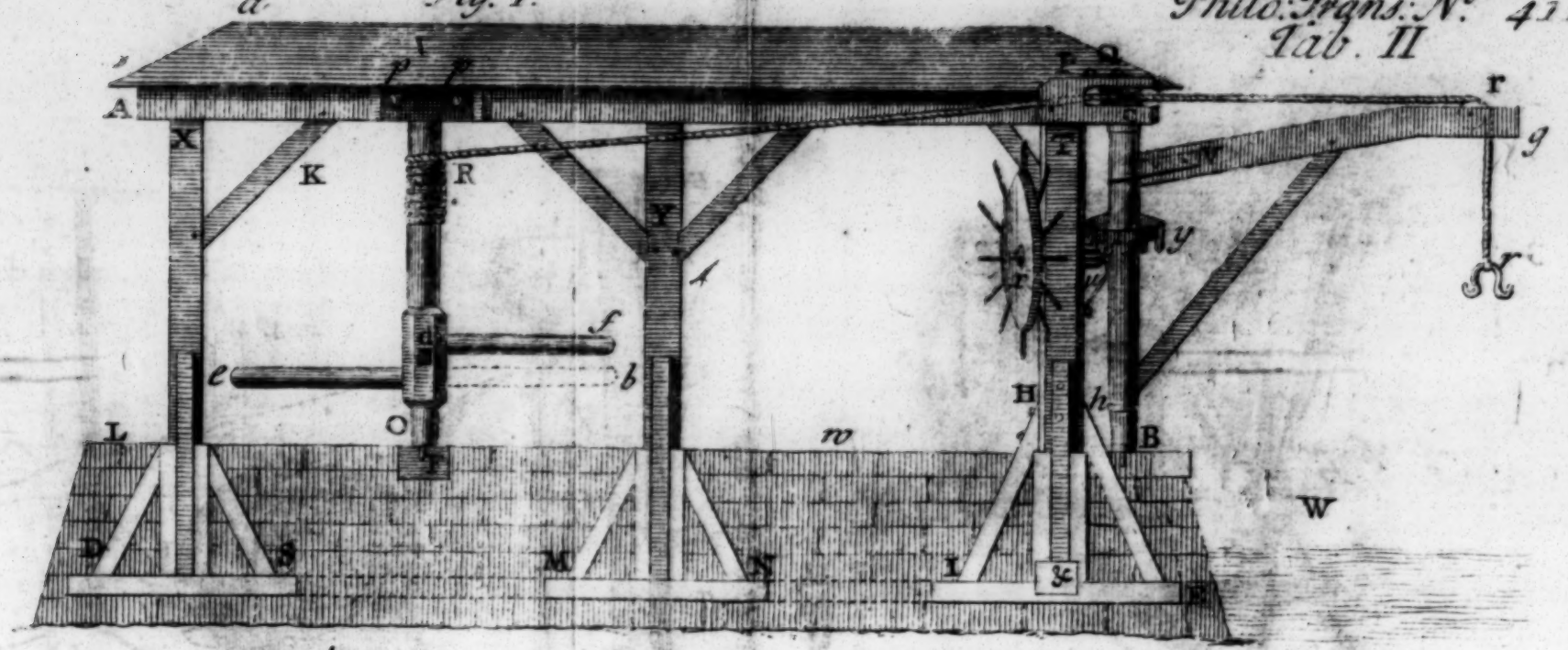




Fig. 2.

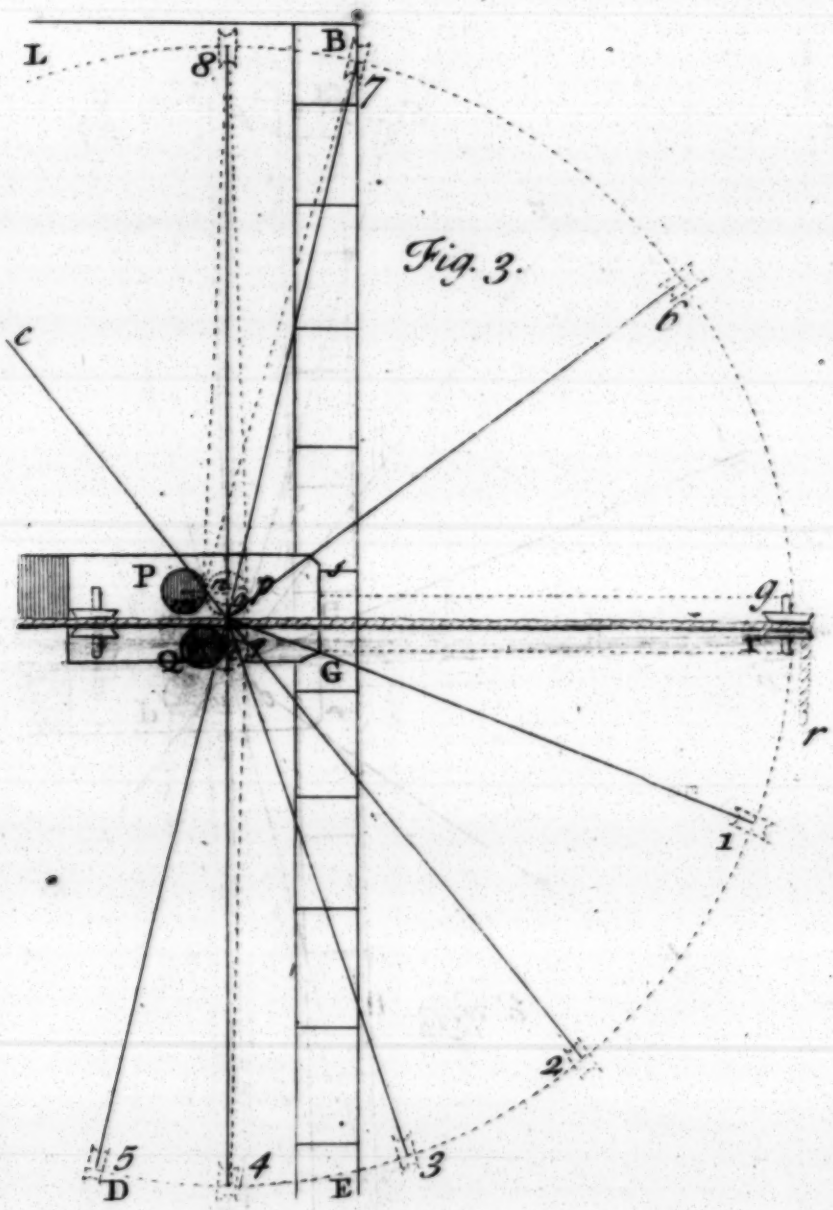


Fig. 3.

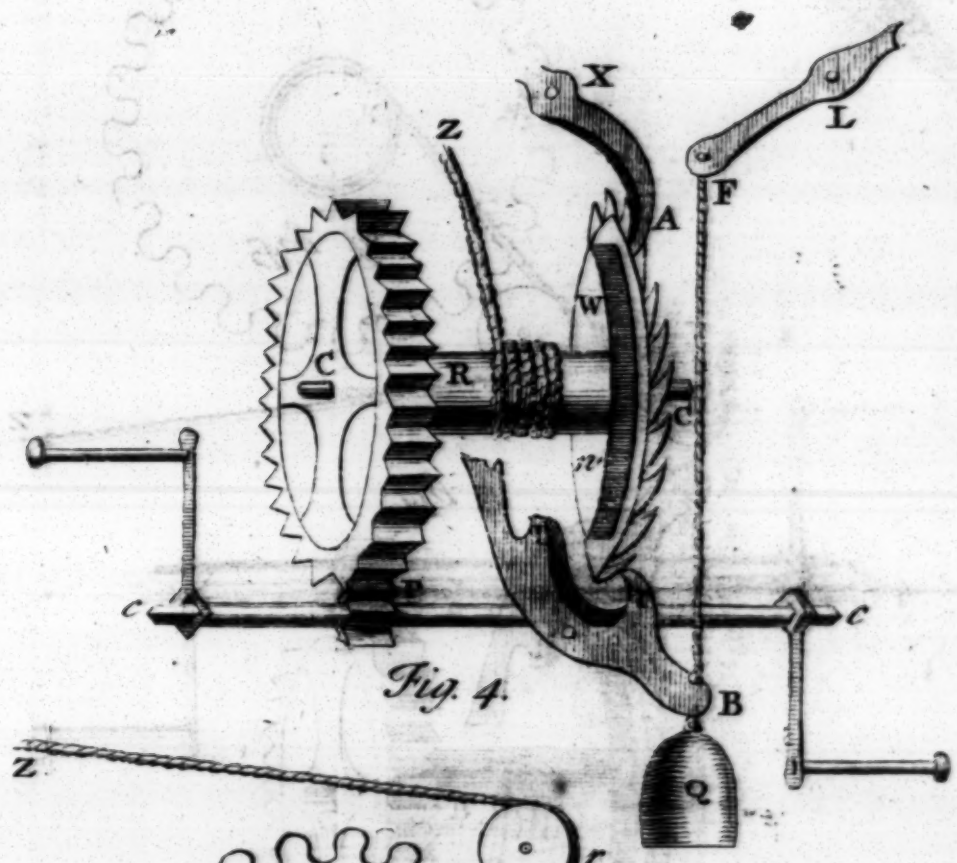


Fig. 4.

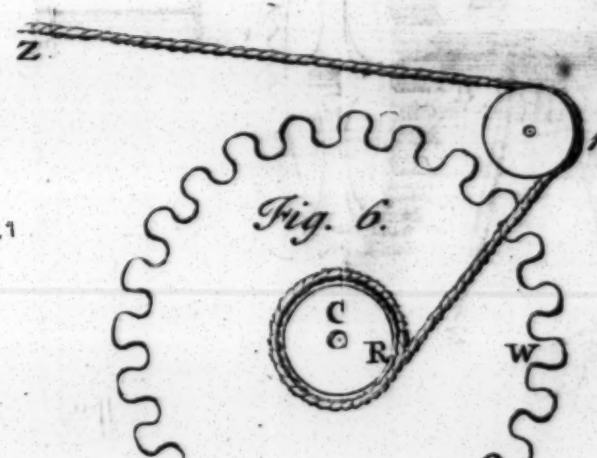


Fig. 6.

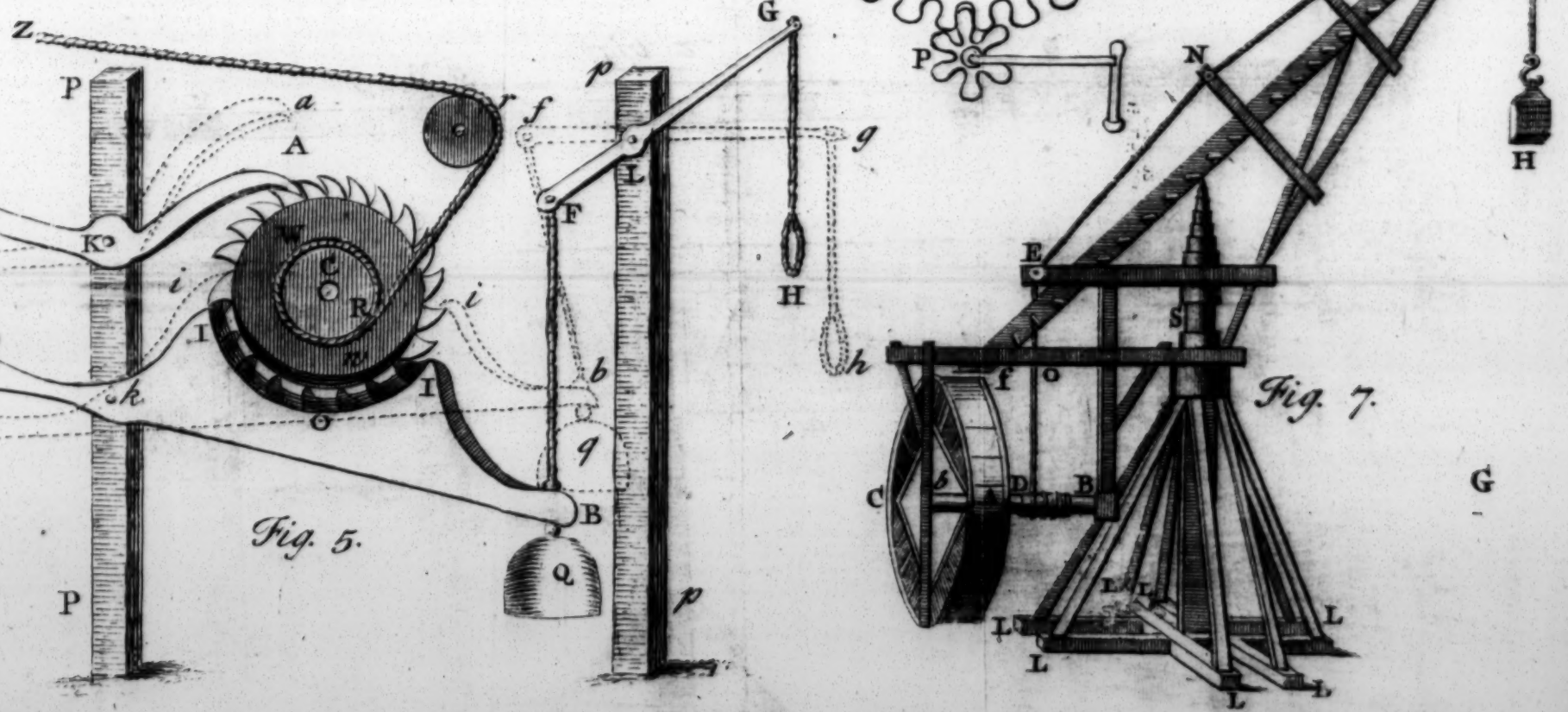
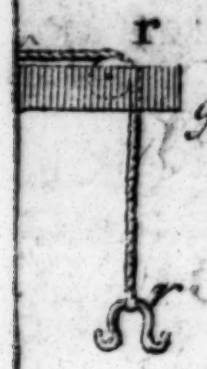


Fig. 5.

Fig. 7.

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An Explanation of the Figures.

Fig. 1. Repreſenting a fix'd Crane with a Gibbet moving on an upright Shaft or Axis.

A *a* Q, The Roof of the Crane to preſerve the Rope R T *r* from the Weather, when the Arm of the Gibbet V G *g* being turn'd towards Y is brought under it.

A T, The upper Piece of the Crane, is an horizontal Situation, call'd *the Plate of the Crane.*

X, Y, Z, The three Crane Poſts brac'd at Top and Bottom.

D S, M N, I E, Three Cills within the Stone Work, brac'd with Wood, and made faſt with an upright Plate of Iron pinn'd to the Wood on each Side.

N. B. *When the Crane is not in Stone Work, the three Cills muſt be all in one Piece, reaching from* D to E.

H I, h E, Are the Braces of the main Poſt of the Crane, which come up above the Level of the Wharf L *w* B, which are longer and ſtronger than the others. Here a croſs Piece whoſe Section is (&) keeps the main Poſt from twiſting.

R O, The Capſtane, or Shaft of the Crane to receive the Rope or Chain; which Shaft is turn'd here by Bars or Handſpikes, ſuch as *b d*, f d, or *e d*, the lower Part being ſtrengthened with Iron Hoops above and below the Holes at *d*, with a Pivot or Iron Axis turning in an Hole in a Piece whoſe Section is F.

p p, Are two Pins, which hold on a Collar in which the upper Part of the Shaft turns.

C B,

C B, The Shaft or Axel of the Gibbet with Pivots and Iron Hoops at Top and Bottom, and a Wheel of Iron, *y*, having Teeth perpendicular to its Plane. This Wheel is led by a Pinion, *u*, which is on the Axis of the Wheel *x*, by whoſe Arms a Man ſtanding at H may bring about the End of the Gibbet *g* with the Ram-head *r*, and the Weight hanging at it, either to the Right or Left, and eaſily hold the Gibbet in any Poſition.

C T P Q, A ſtrong Piece or Block having three Pullies, one vertical, and the other two horizontal, that the Rope may run over the Firſt of them, and between the two others.

Fig. 2. Repreſents an horizontal Section of the Crane in its upper Part, or rather a View of it from the Plane of the Roof, ſuppoſing the Roof taken off.

N. B. *The ſame Letters mark the Parts which have been deſcribed in* Figure 1.

Fig. 3. Shew the Inconveniencies in the Motion of the Gibbet.

L B E D, Repreſents Part of the Wharf next the Water, or Precipice of a Quarry.

T P Q, The Block-Piece which holds the three Pullies, expreſs'd by the ſame Letters in *Fig.* 1 and 2.

s g r G, The Arm of the Gibbet repreſented by V g, *Fig.* 1.

T, The vertical Pulley.

P, Q, The horizontal Pullies, repreſented in another Situation by *p*, *q*, when their Centers from *m*, *y*, are brought to *n* and *t*.

C, Is a Point directly over the Pivot of the Shaft, or Axel of the Gibbet.

C 1, C 2, C 3, C 4, C 5, Repreſents a Line over the Arm of the Gibbet, or rather a Plane going through the Middle of it, in ſeveral of its Situations, when turn'd towards the right Hand, from its direct Poſition C r.

C 6, C 7, C 8, C *c*, Repreſent the ſeveral Situations of the Gibbet towards the Left, the laſt Pulley *r*, at the End of the Gibbet, immediately over the Weight traverſing in the Circle 5, 4, 3, 2, 1, 6, 7, 8.

When the Gibbet is in the Poſition c g, the Rope runs directly over the Middle of its Arm, therefore the leaſt Force applied to r or *r*, can keep in its Place the greateſt Weight that can be drawn up by the Crane, when ſuſpended to the Ram-head. If the Pullies are at *p* and *q*, the Gibbet loaded will alſo be without Labour retain'd in the Poſition C 2 on the Right, and C 6 on the Left, and with no great Trouble in the Poſition C 1.

But if the Gibbet be brought over the Wharf at 4 on the Right, or at 8 on the Left, the Rope will no longer run over the Middle of the Gibbet, but deviate from it, ſo as to make with it the Angle *q* 4 *t*, or *o* 8 n, and raiſe the Weight by the Motion of the Gibbet in Proportion as the Line *q* 4, or *o* 8, is longer than *t* 4, or *n* 8; and therefore the Weight will tend to run back towards g in Proportion to the Difference of thoſe Lines, which muſt give a Twitch to the Perſon who draws from r, or *r* by a guide Rope.

If to prevent this Inconveniency the Pulley at *q* be remov'd back to Q, then indeed the Rope will run over the Line C 4, or *t* 4, and conſequently the Gibbet will be eaſily held in that Situation; but if you have Occaſion to move the Weight to 5, the Rope

touching the Pulley at *t*, will make an Angle with C 5, and again be ſubject to the Inconveniency above-mentioned. Beſides, in bringing the End of the Gibbet from g to 4, the Rope immediately applying itſelf to the Pulley at *t* will come forward with a Jerk, though it will be twitch'd back again when at 5.

If the Pulley be ſet backwarder ſtill, as may be ſeen at P, when you wou'd keep the Weight under 8, it will tend to go on towards *c*, in Proportion as the Rope at *m* 8 is now ſhorter than the Line *n* 8; for now the Weight deſcending a little, the Force of that Deſcent added to the Pull of him who draws the Guide Rope, will cauſe the Weight to ſwing towards the Crane, ſo as ſometimes to do Miſchief, if the Weight be very great, and the Men careleſs.

N. B. No Poſition of the Pullies can mend the Matter, there being only three Situations of the Gibbet in its whole Traverſe, where it can keep its Place when loaded. Therefore the Wheel, *y*, and the Wheel and Pinion, *x u*, in *Fig.* 1. are of very conſiderable Uſe when great Weights are rais'd.

Fig. 4. Repreſents the double Axis in Peritrochio, or Wheel and Pinion us'd inſtead of the walking Wheel of *Fig.* 7.

c, *c*, An Axis with Handles having a Pinion P which leads the Wheel P R to wind the Rope R Z on the Axel R.

K, A, Part of the Catch which ſtops the Rope from running back again.

W *w*, A wooden Wheel of ſome Thickneſs, which (when the Catch is up) is kept from turning too ſwift as the Weight runs down, by pulling up the Semicircular Part of the Pall I o I ſo as to make it bear

hard

hard againſt the Wheel below, to regulate or ſtop the Deſcent of the Weight.

C C, The Pivots or Centers of the Axel.

L F, Part of the Leaver, whereby the Pall is drawn up againſt the Wheel W *w*, by means of the Rope F B.

Q, The Weight to bring down the Pall clear of the Wheel W *w*, when it is not pull'd up.

I o I B, The End of the Pall which is applied to the Wheel, the other End not being repreſented here.

Fig. 5. Shews the Manner of letting down the Weight ſwifter or ſlower as there is Occaſion, repreſenting that End of the Axel on which the Catch and Pall act alternately.

P P and *p p* are two upright Pieces fix'd to the Frame of the Crane, in any manner that is moſt convenient for carrying the three Centers L, K, and *k*.

When the Rope R r Z going over a Pulley at *r*, or any where elſe, draws from the Axel in the Direction R r; the Catch, if its End is at A, keeps it immoveable. But by pulling at H, the Leaver G F riſes at F, and conſequently draws up the End B of the Pall B D; which moving on the Center *k*, does by its End D (by means of the Bar D E) pull down E, and raiſe A of the Catch, ſo as to let the Rope run down; but to prevent its running too faſt, one muſt pull a little harder; then the Semicircle I o I will preſs againſt the Wheel, and ſlacken the Deſcent of the Weight; which will be wholly ſtopp'd by pulling ſtill harder: Then the Leaver, Pall, and Catch will be in the Poſition mark'd by prick'd Lines and ſmall Letters. Now if the Perſon holding H, ſhou'd careleſly let it go, the Weight Q in deſcending will bring down the Pall at B, and

raiſe its other End, ſo as to throw the Catch in again upon the Teeth of the Ratchet, and ſtop the whole Motion without Accidents.

The 6th *Figure* repreſents the Wheel and Pinion at the other End of the Axis, where the ſame Letters expreſs the ſame Parts.

The 7th Figure repreſents the Crane with the walking Wheel, the whole turning round upon the ſtrong Poſt or Puncheon S, which is fix'd ſteadily upright by Means of the Braces and Cills L L L L L L L L L; and when the Wheel and Pinion is us'd inſtead of the walking Wheel, all the other Parts are the ſame.

f F, Is a Brace and Ladder.

E, N, M, F, Pullies for the Rope to run over, and come to the Weight at H.

N. B. Sometimes a Pair of Blocks is applied between F and H. A ſmall wooden Roof alſo is applied over the Ends of the Pieces at E, N, M, and F.

V. *Of the* Meteor *called the* Ignis Fatuus, *from Obſervations made in* England, *by the Reverend Mr.* W. Derham, *F. R. S. and others in* Italy, *communicated by Sir* Tho. Dereham, *Bart. F. R. S.*

IT being the Opinion of divers skilful Naturaliſts (particularly Mr. *Fr. Willughby* and Mr. *Ray*) that the *Ignes Fatui* are only the Shining of a great Number of the *Male-Gloworms* in *England*, or of the *Pyrauſtæ* in *Italy*, flying together, I was mind-

ed

ed to conſult my curious and ingenious Friend, Sir *Tho. Dereham*, about the *Phœnomenon*, being informed, that thoſe *Ignes Fatui* are common in all the *Italian* Parts. But of the *Pyrauſtæ*, or *Fire-flies*, he ſaith, *He never obſerved any ſuch Effects, although there is an immenſe Number of them in* June *and* July. He ſaith moreover, that theſe *Pyrauſtæ* are called *Lucciole*, i. e. *Small Lights*, and that they are not the *Farfalls* (as Mr. *Ray* thought) which are *Butter-flies*.

But I have good Reaſon to think, that Inſects are not concerned in the *Ignes Fatui*, from the following Obſervations; the Firſt of which I made my ſelf, and the others I received from *Italy*, by the Favour of Sir *Tho. Dereham*.

My own Obſervation I made at a Place that lay in a Valley between Rocky Hills, which I ſuſpect might contain Minerals, in ſome Boggy Ground near the Bottom of thoſe Hills. Where, ſeeing one in a calm, dark Night, with gentle Approaches I got up by Degrees within two or three Yards of it, and viewed it with all the Care I poſſibly could. I found it friſking about a dead Thiſtle growing in the Field, until a ſmall Motion of the Air (even ſuch as was cauſed only by the Approximation of my ſelf) made it skip to another Place, and thence to another, and another.

It is now about fifty-five Years ſince I ſaw this Phœnomenon, but I have as freſh and perfect an Idea of it, as if it was but of a few Days. And as I took it then, ſo I am of the ſame Opinion now, that it was a *fired Vapour*.

The *Male-Gloworms* I know emit their ſhining Light, as they fly; by which Means they diſcover

and

and woo the Females: but I never obſerved them to fly together in ſo great Numbers, as to make a Light equal to an *Ignis Fatuus*. And I was ſo near, that had it been the Shining of Gloworms, I muſt have ſeen it in little diſtinct Spots of Light; but it was one continuous Body of Light.

Having thus related my own Obſervations of the *Ignes Fatui*, I ſhall next give an Account of the Obſervations which Sir *Tho. Dereham* procured for me in *Italy*, in the following Letter of Dr. *Giacomo Bartholomeo Beccari*, F. R S. to Sir *T. Dereham*, F. R. S. dated at *Bologna*, *Octob.* 23, 1728, and tranſlated from the *Italian*, by the late Dr. *Joh. Caſpar Scheuchzer*. Which Letter is in theſe Words.

'TIS purely in Obedience to your Commands, by Dr. *Euſtachio Manfredi*, I ſend you the following Obſervations on the *Ignes Fatui*. What I am now going to offer to you concerning theſe fiery Appearances, is the Reſult of ſeveral Converſations I had upon this Subject with ſeveral experienced Travellers, Men of Learning and Reputation, whoſe Sincerity I had no Reaſon to miſtruſt. For my own farther Satisfaction, ever ſince I received your Commands, I have made it my Buſineſs to ſpeak with as many as I could light of, with ſuch as travelled much in the Mountains, and with others that obſerved them in Plains, on Purpoſe to ſee whether or no the Difference of the Place made any ſenſible Difference in the Appearance. I find upon the Whole, that they are pretty common in all the Territory of *Bologna*. To begin with the Plains, they are very frequently obſerved there; the Country Peo-

ple

ple call them *Cularſi*, perhaps from ſome fancied Similitude to thoſe Birds, and becauſe they look upon them as Birds, the Belly and other Parts of which are reſplendent like our ſhining Flies. They are moſt frequent in watry and moraſſy Ground, and there are ſome ſuch Places, where one may be almoſt ſure of ſeeing them every Night, if it be dark. In the Fields near the Bridge *Della Calcarata*, in a Common belonging to the Pariſh of *S. Maria in dono*, North of *Bologna*, one of theſe fiery Appearances is very often obſerved to move a-croſs the Fields, coming from another Bridge, called *Della Foſſa quadra*. There is another of them in the Fields of *Bagnara*, almoſt Eaſt of *Bologna*, which ſcarce ever fails to appear in dark Nights, particularly when it rains, or ſnows, as alſo in cold and froſty Weather. Both theſe, I mean that near the Bridge of *Calcarata*, and that in the Fields of *Bagnara*, are very large; and I am aſſured, that ſometimes their Light is equal to that of one of our ordinary Faggots or Bundles made of Branches of Vines, and that it is ſcarce ever leſs than that of the Links which our Country People make of Hemp-ſtalks, and which they light themſelves withal, when they travel at Night. That at *Bagnara* appeared, not long ſince, to a Gentleman of my Acquaintance, as he was travelling that Way; it kept him Company for a Mile or better, conſtantly moving before him, and caſting a ſtronger Light on the Road, than the Link he had with him.

I believe there may be many more in other Plains as large as theſe two, though at preſent I have not been able to get certain Information of any others. Leſſer ones there appear a good many, ſome of them giving

giving as much Light as a lighted Torch, and ſome there are no bigger than the Flame of a common Candle. Of theſe, I have been aſſured, a good many were ſeen in the Fields of *Bariſella*. All of them have the ſame Property in reſembling both in Colour and Light, a Flame ſtrong enough to reflect a Luſtre upon Neighbouring Objects all round. They are continually in Motion, but this Motion is various and uncertain. Sometimes they riſe up, at others they ſink. Sometimes they diſappear of a ſudden, and appear again in an Inſtant in ſome other Place. Commonly they keep hovering about ſix Foot from the Ground. As they differ in Largeneſs, ſo they do in Figure, ſpreading ſometimes pretty wide, and then again contracting themſelves. Sometimes breaking to all Appearance into two, and a very little while after meeting again into one Body; ſometimes floating like Waves, and letting drop ſome Parts like Sparks out of a Fire. I have been aſſured, that there is no dark Night all the Year round, when they do not appear. And in the very Middle of the Winter, when the Weather is very cold, and the Ground covered with Snow, they are obſerved more frequently than in the hotteſt Summer. The Gentleman who obliged me with an Account of that at *Bagnara*, told me, that if I had a Mind to ſee it my ſelf, I might be ſure of finding it if I went thither in very cold Weather, and in a ſharp Froſt. Nor doth either Rain or Snow in any wiſe prevent or hinder their Appearance; on the Contrary, they are more frequently obſerved, and caſt a ſtronger Light in rainy and wet Weather. This laſt Circumſtance indeed hath been taken Notice of by ſome Writers, and among

among the reſt, if I remember right, by the learned *Gaſſendi*. Neither doth the Wind much hurt them, though one ſhould think, that if it was a burning Subſtance, like common Fire, it ſhould either be diſſipated in windy Weather, or extinguiſhed by Rain. But ſince they do not receive any Damage from wet Weather, and ſince, on the other Hand, it hath never been obſerved, that any thing was thereby ſet on Fire, though they muſt needs in their moving to and fro, meet with a good many combuſtible Subſtances, it may from thence be very reaſonably inferr'd, that they have ſome Reſemblance to that Sort of Phoſphorus which doth indeed ſhine in the Dark, but doth not burn any thing as common Fire doth. Nor is there any thing extraordinary in this, any more than in other fiery Appearances, which I am informed are likewiſe pretty common, and agree with the *Ignes Fatui*, in having only the Splendor and Appearance of Fire, without the Quality of Burning, but differ from them in a good many other Particulars. Such a Phœnomenon was obſerved by a noted Clergy-man of this City, one Summer's Evening, near ſome Country Peoples Houſes. The Flame ſeem'd to him ſo ſtrong, that he called to them to put it out, for fear it ſhould reach a Hay-loft, and a Heap of Hemp that lay not far from it; but when he came to the very Place where he had firſt ſeen the Flame, he perceived that it was only an Appearance, obſerving not the leaſt Footſtep of Fire, though he aſſured me there lay a good deal of combuſtible Stuff all thereabouts, which would have eaſily took Fire, if there had been any thing of an actual Flame upon the Spot. The ſame Gentleman told me, that in a

very dry Summer (I do not know whether the ſame with the foregoing) he obſerved, in the Middle of ſome other Fields of his own, for ſeveral Evenings together, a pretty conſiderable Flame on the Ground, nearly in the ſame Place, and that having reſolved to go and take a nearer View of it the next Evening, it did not appear for that Time; that, however, he went to the Place where he had before ſeen it, and ſat himſelf down on the Ground, but could not obſerve the leaſt Mark of any Fire or Flame having been in that Spot, nor feel any Heat in the Ground any more than in other Places; only he ſaw ſome ſlight Flames ariſing out of the Ground hard by, which diſappeared as ſoon as they came into the open Air. It is well known to People that travel on Horſeback at the Beginning of the Night, in the Heat of the Summer, when they traverſe the dry Beds of Rivers, and break with their Horſes Feet thoſe ſandy Grounds that have been all Day long ſtrongly heated by the Sun, there riſe up ſome bluiſh Flames, which very often fright the Horſes. This Phœnomenon is moſt common in thoſe Places where the Water hath left behind a kind of a chalky Sediment, or fat Earth, which drying, afterwards forms a thick hard Cruſt. So likewiſe if in the Heat of the Summer you travel in dark Nights, either on Horſeback, or on Foot, over the burnt-up Ground of ſome Fields, you ſhall ſee Flames break out of the Ground almoſt at every Step. All theſe Fires and Flames have indeed the Light and Shining, but not the Burning Quality of Fire, whether from the extream Smallneſs and Rarity of their Parts, as ſome apprehend, or for ſome other Reaſon, I will not attempt to determine. And this is the only Thing

they

they have in common with the *Ignes Fatui*, differing very much in other Reſpects, particularly in not appearing at all Seaſons of the Year, and moſt frequently in the Winter, as the others do. Thus far, what I could learn concerning the *Will with a Wiſp*, as it hath been obſerved in the Plains. As to the Appearance of this Phœnomenon in mountainous Parts, by what I have hitherto been able to learn, they differ in nothing elſe but in Largeneſs; and all thoſe I converſed with, that ſaw them in the Mountains, agree in that they never obſerved any larger than the Flame of an ordinary Candle. Nor do thoſe that live in the Mountains call them *Culaſſi*, which Name is perhaps uſed only by the Country People in the Plains for thoſe large ones above deſcribed. I will make it my Buſineſs to enquire a little farther into this Matter, if perhaps the large ones are ſeen in the Plains only, and thoſe in the Mountains are always ſmall. The Difference of the Air, and that of the Soil may, for ought I know, contribute a great deal towards the different Size of theſe Appearances; at leaſt all that I can offer material at preſent towards ſolving this particular Circumſtance, with Regard to their Largeneſs, is, that thoſe Grounds, where we obſerve the largeſt Fires, as at *Bagnara*, are what they here call *ſtrong Ground* (*terreni forti*) being a hard chalky and clayey Soil, which will harbour the Water a long while, and is afterwards, in hot Weather, very apt to break into large Cracks and Fiſſures; whereas on the contrary, thoſe Soils in the Mountains, where they obſerve the ſmall Fires, are what they call ſoft, or *ſweet Ground* (*terreni dolci*) being generally ſandy, and of a more looſe Contexture, which do not

keep the Water ſo long as the others. Of that Sort alſo is the Soil in the abovementioned Plains of *Bariſella*, where, about ſeven or eight Years ſince, they obſerved a good Number of the ſmalleſt *Ignes Fatui* in the Fields, within the Compaſs of about three Miles. One Thing I will beg Leave to add, that according to the beſt Informations I have hitherto been able to procure, theſe Lights are great Friends to Brooks and Rivers, being frequently obſerved along the Banks of them, perhaps becauſe the Air carries them thither more eaſily than any where elſe. In all other Particulars, as in their Motion, the Manner of their Appearance, their diſappearing ſometimes very ſuddenly, their Light, the Height they riſe to, and their not being affected either by rainy or cold Weather, they are the very ſame with the *Culârſi* above deſcribed, or the large *Will with a Wiſp*, as obſerved in the Plains.

I intended here to have cloſed this Account, but I cannot forbear adding the following Obſervation, which in my Opinion is very curious and ſingular. I am indebted for it to a young Gentleman, a very accurate and knowing Obſerver of natural Appearances. Travelling ſometime in *March* laſt, between eight and nine in the Evening, in a mountainous Road not far from our Lady *del Sarſo*, about ten Miles South of *Bologna*, as he approached a certain River called *Rioverde*, he perceived a Light, which ſhone very ſtrongly upon ſome Stones that lay upon the Banks. It ſeemed to be about two Foot above the Stones, and not far from the Water of the River: In Figure and Largeneſs it had the Appearance of a *Parallelopiped*, ſomewhat above a *Bologneſe* Foot in Length, and about

about half a Foot high, its longeſt Side lying parallel to the Horizon: Its Light was very ſtrong, inſomuch that he could very plainly diſtinguiſh by it Part of a neighbouring Hedge, and the Water in the River; only in the Eaſt Corner of it the Light was pretty faint, and the ſquare Figure leſs perfect, as if cut off, or darkened by the Segment of a Circle. The Gentleman's Curioſity tempted him to examine it a little nearer; in order to which he advanced gently towards the Place, but was ſurprized to find, that inſenſibly it changed from a bright Red to a yellowiſh, and then to a pale Colour, in Proportion as he drew nearer, and that when he came to the Place it ſelf, it was quite vaniſhed. Upon this he ſtepp'd back, and not only ſaw it again, but found that the farther he went from it, the ſtronger and brighter it grew; nor could he upon narrowly viewing the Place where this fiery Appearance was, perceive the leaſt Blackneſs, or Smell, or any Mark of an actual Fire. The ſame Obſervation was confirmed to me by another Gentleman, who frequently travels that Way, and who aſſured me, that he had ſeen the very ſame Light five or ſix different Times, in *Spring* and *Autumn*, and that he had always obſerved it in the very ſame Shape and the ſame Place, which to me ſeems very difficult to be accounted for. He told me farther, that once he took particular Notice of its coming out of a neighbouring Place, and then ſettling it ſelf into the Figure above deſcribed. How it comes to paſs, that the nearer one approaches to theſe, or the like fiery Appearances, the fainter they grow, till at laſt they diſappear totally, I very freely own my ſelf at a Loſs, but yet I cannot help thinking, that there is ſome-

thing

thing in it analogous to what we obſerve in Fogs and Clouds, which at a Diſtance have indeed the Appearance of very thick Bodies, but are found more rare as one gets into them. Nor is it improbable, as they muſt be ſomething very thin and ſubtle, that upon the Approach of groſſer Bodies with their Atmoſpheres, they are actually driven away.

This is the Subſtance of what I have been able to gather from ſeveral Accounts relating to the *Ignes Fatui*; but as to the Cauſes of them, I will not pretend to aſſign any: I will only add, that all that ever ſaw any of theſe fiery Appearances agree, and you may aſſure Mr. *Derham* of it, that they caſt a Light quite different from that of the *ſhining Flies*; and if you pleaſe to reflect on the ſeveral Circumſtances above related, I believe you will find, that they are not eaſily, if at all, to be ſolved by that Hypotheſis. I intend in another Letter to trouble you with ſome Queſtions, and likewiſe ſome Obſervations of my own on *theſe Flies*, mean while,

I am, &c.

VI. *Duæ Obſervationes Eclipſis Lunæ Totalis Nocte ſequente Diem* 28 Julij 1729. S. V. *Communicante Cl.* Thomâ Dereham, *Bart. & R. S. S.*

Obſervatio in publico Obſervatio Bononiæ *facta. à Dno.* Euſtachio Manfredi, *M. D. R. S. S.* &c.

Temp. Ver.
H. ′ ″

11 56 52 Eclipſis certè incepta.
12 11 33 Initium *Copernici.*
12 56 Centrum *Copernici,* ſed ex alterâ Determinatione 2″ citiùs.
19 46 Initium *Tychonis,* ſed ex alterâ Determinat. 2″ citiùs.
20 54 Medium *Tychonis.*
21 43 Totum *Tychonem.*
23 43 Initium *Platonis.*
24 42 Medium *Platonis.*
25 23 Totum *Patonem.*
25 55 *Inſula in Sinu medio.*
27 35 Totum *Manilium.*
29 35 Totum *Ariſtotelem.*
32 7 Totum *Menelaum.*
35 0 Totum *Plinium.*
38 49 *Promontorium ſomni.*
39 26 *Promontorium acutum.*
44 16 Totum *Fracaſtorium.*
45 42 Totum *Proclum.*
46 59 Initium *Maris Criſium.*

Medium

Temp. Ver. H.	′	″	
12	49	47	Medium *Maris Criſium*, ſed ex alterâ Determinat. 4″ citiùs.
	52	19	Totum *Mare Criſium.*
	53	6	Totum *Petavium.*
12	55	54	Totalis Immerſio Lunæ.
14	34	25	Initium Emerſionis dub.
	37	30	Initium *Grimaldi.*
	38	20	Totum *Galileum.*
	38	28	Totum *Grimaldum.*
	39	45	Totum *Ariſtarchum.*
	44	47	Totum *Keplerum.*
	48	33	Initium *Platonis.*
	49	37	Medium *Platonis.*
	50	42	Totum *Platonem.*
	52	47	Totum *Copernicum.*
	55	32	Totum *Bullialdum.*
15	1	56	Initium *Tychonis.*
	2	36	Medium *Tychonis.*
	3	50	Totum *Tychonem.*
	4	50	Totum *Manilium.*
	7	47	Totum *Menelaum.*
	11	2	Totum *Dyoniſium.*
	11	37	Totum *Plinium.*
	18	53	*Promontorium acutum.*
	20	30	Initium *Maris Criſium.*
	20	59	Totum *Proclum.*
	23	34	Medium *Maris Criſium.*
15	35	00	Finis Eclipſis.

Obſervatio

Obſervatio Eclipſis Lunaris in Collegio Romano Societatis Jeſu, *t. p. m. u.*

	Immerſiones.	H.	′	″
Umbra ad ☽ limbum		12	01	00
Kepleri,	Initium		07	49
	Medium		09	04
	Finis		09	50
Copernici,	Initium		15	00
	Medium		16	26
	Finis		17	00
Heraclidis,	Initium		17	11
	Medium		17	27
	Finis		17	40
Heliconis,	Initium		22	26
	Medium		22	41
	Finis		23	07
Tychonis,	Initium		23	50
	Medium		24	41
	Finis		25	25
Platonis,	Initium		28	43
	Medium		29	14
	Finis		29	50
Manilij,	Initium		31	05
	Medium		32	00
	Finis		32	45
Menelai,	Initium		35	04
	Medium		35	45
	Finis		36	08
Maris Criſium.	Initium		51	37
	Medium		54	10
	Finis		56	08
Totalis Immerſio		13	00	16

Emerſiones.		H.	′	″
Lux ad ☽ limbum		14	38	24
Grimaldi Finis			43	24
Kepleri Finis			44	34
Heraclidis,	Initium		46	14
	Medium		46	54
	Finis		47	24
Heliconis,	Initium		49	10
	Medium		50	04
	Finis		50	44
Platonis,	Initium		51	24
	Medium		52	09
	Finis		52	44
Tychonis,	Initium	15	07	05
	Medium		07	13
	Finis		08	18
Maris Criſium,	Initium		26	39
	Medium		28	38
	Finis		31	51
Totalis emerſio			38	00

Obſervationes habitæ ſunt teleſcopio pedum Romanorum 9, aere innubi, ſed vaporoſo ita, ut circa Eclipſis finem limbus Lunaris tremere videretur. Diameter Lunæ horizontalis capta 15 h. 46′ intercipiebat micrometri partes 2934, quarum verticalis Lunæ diameter comprehendebat 2877, at Solis diameter die præcedenti viſa eſt occupare partes 2830.

	H.	′	″
Tempus Immerſionis		59	16
Tempus Emerſionis		59	36
Mora in tenebris	1	38	08
Duratio Eclipſis	3	37	00

Solis Meridiani refractione omiſſâ tangentes in Gnomone, cujus aperturæ horizontalis diameter

7 Auguſti	48	19	90
	47	04	40
8 Auguſti	48	80	01
	47	73	01

70

100000

FINIS.

Numb. 412.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *January* and *February*, 1730.

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I. *A Catalogue of the fifty Plants from* Chelsea-Garden, *presented to the* Royal Society, *by the Company of* Apothecaries, *for the Year* 1728; *pursuant to the Direction of Sir* Hans Sloane, *Bart. Med. Reg. Præs. Col. Reg. Med. & Soc. Reg. By* Isaac Rand, *Apothecary, F. R. S.*

II. *An Examination of Monsieur* Perrault's *new-invented* Axis in Peritrochio, *said to be entirely void of Friction: With an Experiment to confirm the Reasoning made upon an* Axis in Peritrochio *first us'd in Mons.* Perrault's *Manner, then in the common Way, by* J. T. Desaguliers, *L L. D.*

III. *A*

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IV. DE EQVVLEO: *Auctore* Joanne Wardo, *Rhet. Prof. Greſh. et R. S. S.*

V. *An Account of a Treatiſe entituled,* Calculations and Tables relating to the attractive Virtue of Loadſtones, *&c. Printed* Anno 1729.

VI. *An Account of a Book entituled,* Jo. Frider. Weidleri Obſervationes Meteorologicæ & Aſtronomicæ, Annorum 1728 & 1729, *&c.* Wittembergæ, Anno 1729.

VII. *Occultatio Veneris à Lunâ ſubeunte* Berolini *viſa die* 19 Septembris, 1729, N. S. *p.mer. à D.* Kirchio. *Ex Diario Meteorologico (M.S.)* J. Fred. Weidleri, *L. L. D. & Math. Prof. Prim.* Wittembergæ.

Jos: Banks

I. *A* Ca-

I. *A Catalogue of the fifty Plants from* Chelſea-Garden, *preſented to the* Royal Society, *by the Company of* Apothecaries, *for the Year* 1728; *purſuant to the Direction of Sir* Hans Sloane, *Bart. Med. Reg. Præſ. Col. Reg. Med. & Soc. Reg. By* Iſaac Rand, *Apothecary, F. R. S.*

301. ANONIS Americana; folio latiori, ſubrotundo. T. Inſt. 409.
302. Apocynum fruteſcens; Salicis folio, anguſto. *An Apocynum erectum, Africanum; Villoſo fructu; Salicis folio, glabro, anguſto. Par. Bat.* 24.
303. After Americanus, ſerotinus, altiſſimus; folio brevi, caulem amplectente.
304. Betonica maxima; Scrophulariæ folio; flore e luteo palleſcente. Schol. Bot. 64.
305. Betonica maxima; Scrophulariæ folio; floribus incarnatis. Par. Bat. 106.
306. Chamædrys; vulgo vera exiſtimata. J. B. 3. 288.
307. Chamædrys; foliis parvis levitèr crenatis.
308. Chamædrys; fruteſcens; Teucrium vulgo. T. Inſt. 205.
309. Chamædrys; laciniatis foliis. Lob. Icon. 385.
310. Chamædrys; quæ *Teucrium Hiſpanicum, ſupinum*; *Verbenæ tenuifoliæ foliis. D. Goiffon. D. Juſſieu.*
311. Commelina graminea, latifolia; flore cæruleo. Plum. N. Gen. Plant.

312. Conyza Orientalis, humilis; Verbaſci folio, candidiſſimo.

An Conyza tomentoſa & candidiſſima; ſubrotundo, craſſo folio; flore luteo. D. Sherard. Ac. Reg. Sc. Par. Anno 1719?

313. Corona Solis; Trachelii folio; radice repente. T. Inſt. 490.

314. Corona Solis; Trachelii folio, ramoſior; radice non repente.

315. Corona Solis; Trachelii folio, tenuiore; calyce floris foliato.

316. Cotinus coriaria. Dod. 780.

317. Doria major, repens.

Virga aurea maxima; radice repente; ſive Dorea major, repens. D. Bobart. Hiſt. Ox. 3. 123.

318. Doria; foliis tenuitèr ſerratis, ad caulem latis.

An Aliſma Monſpelienſium; ſive Doria. J. B. 2. 1064?

319. Doria; quæ *Jacobæa, Orientalis; Limonii folio. T. Cor. 36.*

320. Elatine; folio acuminato in baſi auriculato; flore luteo. C. B. 253.

321. Elatine; folio ſubrotundo. Ib.

322. Elatine Hiſpanica, rotundifolia; pediculis florum breviſſimis.

323. Ferrum equinum, Germanicum; ſiliquis in ſummitate. C. B. 349.

324. Geranium Ægyptiacum; Althææ folio, ſubtùs glauco. Lippii. D. Juſſieu.

325. Geranium Alpinum; Coriandri folio; longiùs radicatum; flore purpureo. D. Micheli. Hort. Piſan. 68.

326. Her-

326. Hermannia fruteſcens; folio Ibiſci, hirſuto, molli; caule piloſo. Boerh. Ind. 1. 115.

327. Hermannia; Alni folio parvo.

An Ketmia Africana, fruticans & erecta; Alni foliis latioribus & majoribus; flore Spirali Sulphureo. Hort. Amſt. p. 2. 155?

328. Hermannia; minimo Alni folio.

An Ketmia, &c. *Foliis triplo minoribus. Ib?*

329. Jacobæa Hiſpanica, minùs laciniata; petalis breviſſimis. T. Inſt. 486.

330. Jaſminum Arabicum; Caſtaneæ folio; flore albo, adoratiſſimo; cujus fructus Coffy in officinis. Boerh. Ind. alt. 217. *Arbor Yemenſis fructum Cofè ferens. D. Douglas.*

331. Linaria vulgaris lutea; flore majore. C. B. 212.

332. Linaria lutea elatior & ramoſior; flore minori.

333. Linaria, Hiſpanica, procumbens; foliis uncialibus, glaucis; flore flaveſcente, pulchrè ſtriato, labiis nigro-purpureis.

334. Linaria multicaulis, erecta annua; anguſto Molluginis folio; floribus luteis rarè diſpoſitis.

335. Lactuca perennis, humilior; flore cœruleo. T. Inſt. 473.

336. Parietaria Officinarum & Dioſcoridis. C. B. 121.

337. Parietaria vulgaris, Anglica. *Parietaria minor, Ocimi folio. C. B. Ib.*

338. Partheniaſtrum Americanum; Ambroſiæ folio. Ac. Reg. Sc. Par.

339. Ricinoides arbor, Americana; folio multifido. T. Inſt. 656.

340. Satureia montana. C. B. 218.

341. Satureia montana; latiori folio; ramulis minùs erectis.

342. Sclarea, folio Salviæ, minor, ſive glabra. T. Inſt. 180.
343. Sclarea, folio triangulari; caule tomentoſo. Ib.
344. Tribulus terreſtris. J. B. 2. 352.
345. Tribulus terreſtris, hexaphyllos, Americanus. *An Tribulus terreſtris major; flore maximo, odorato. Sloan. Hiſt. Vol. I. p.* 209. *Tab.* 132. *Fig.* 1 ? ?
346. Trifolium, anguſtifolium ſpicatum. J. B. 2. 376.
347. Trifolium arvenſe, humile, ſpicatum ſive Lagopus. C. B. 328. foliis latioribus. *Lagopodium Lagopus. Tab. Icon.* 524.
348. Trifolium, Lagopus dictum, anguſtioribus foliis. *Lagopus Lob. Icon.* 39.
349. Trifolium pratenſe, hirſutum, majus; flore albo Sulphureo. Raii Syn. Ed. 2. 193.
350. Trifolium pratenſe, folliculatum. C. B. 329.

II. *An Examination of Monſieur* Perault's *new-invented* Axis in Peritrochio, *ſaid to be entirely void of Friction: With an Experiment to confirm the Reaſoning made upon an* Axis in Peritrochio *firſt us'd in Monſ.* Perault's *Manner, then in the common Way, by* J. T. Deſaguliers, *L L. D.*

AS the Recommendation and Contrivance of a Perſon, who is conſiderable in mechanical Performances, is a great Inducement for others to make uſe of

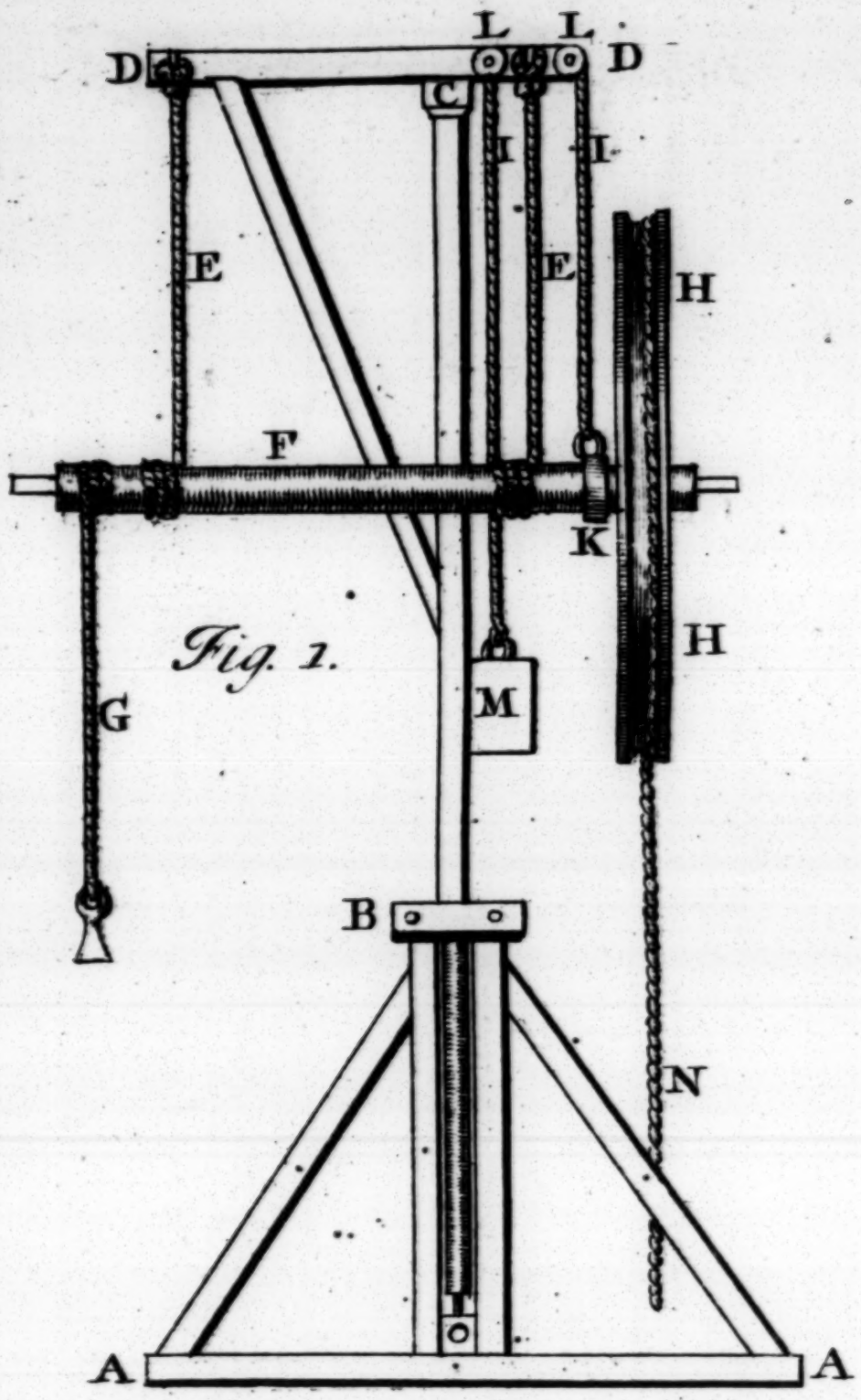


Fig. 1.

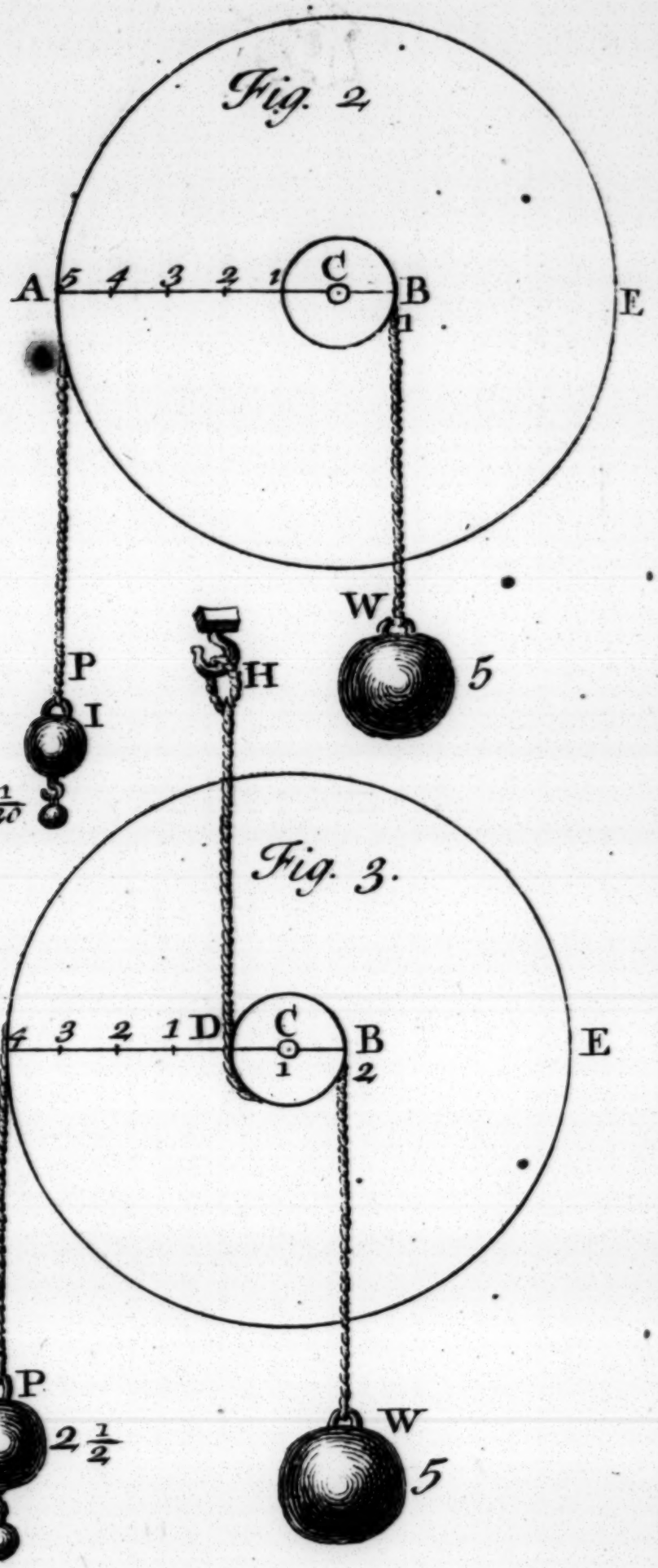


Fig. 2.

Fig. 3.

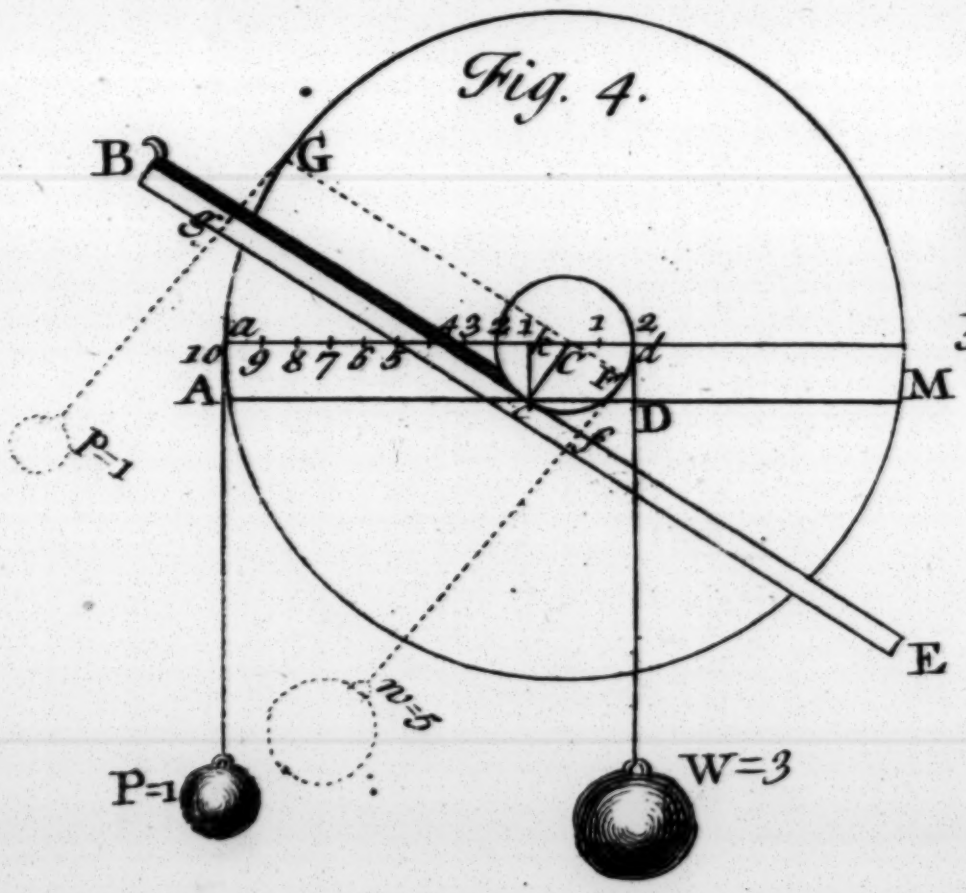


Fig. 4.

of a new Machine, which he affirms to have anſwer'd, in Practice, beyond any other us'd for the ſame Purpoſe; ſo I thought it wou'd be an Advantage to thoſe who have Occaſion for Machines, to ſhew the Imperfection of ſuch an Engine, when the Author of it has been miſtaken; thereby to prevent needleſs Expence and Diſappointment, in erecting and trying ſuch kind of Machines.

Monſieur *Perault*'s Account of his Engine is as follows: "In Imitation of the (modern) Crane, "I have invented two Engines for raiſing Weights. "The firſt is made of that Organ which is the moſt ad- "vantageous of any in Mechanicks, for facilitating Mo- "tion; becauſe it is free from that Inconveniency which "we meet with in all others; namely, the Friction "of the Parts of the Machine, which renders their "Motion more difficult. This Organ is the Roller, "which *Ariſtotle* prefers to all other Organs, be- "cauſe all the others, as Wheels, Capſtanes, and Pul- "lies, muſt neceſſarily rub in ſome of their Parts. "But the Difficulty was to apply the Roller to an "Engine that raiſes Weights, its Uſe having only "been hitherto to cauſe them to roll on an horizon- "tal Plane. The Engine which I propoſe has a Baſe "A A B, (Plate I. Fig. 1.) ſomething like the Crane: "This Baſe has in its upper Part the horizontal Pieces "B, which claſps an upright Shaft C C, ſupported un- "der its Pivot C, on which the whole Engine moves in "the ſame manner as the Crane, when the Weight is to "be lower'd. This Shaft ſupports on its Top a croſs "Piece D D, to which are faſten'd the Ropes E E, "which wrap round the Barrel, Axel, or Roller F, "which has another Rope G, that alſo wraps or winds

"round

" round one of its Ends. This laſt Rope is that which
" raiſes the Weight. At the other End of the Axel
" there is a great wooden Wheel like a Pully H H,
" about which is wound a long Rope N.

" To work this Engine, one muſt pull the long Rope
" N, which cauſing the great Wheel to turn, does alſo
" carry round the Axel or Barrel, which is made faſt
" to it. This Axel, as it turns round, cauſes the
" Ropes E E to wind about it, and thereby the Axel
" and the Wheel riſe, whilſt the Rope F, to which
" the Weight is faſten'd, does alſo wind itſelf up upon
" the Axel the contrary Way; and this double wind-
" ing up of the Ropes makes both the Burthen and
" the Axel and Wheel to riſe at the ſame Time. Now
" it is evident, that all this Riſe is perform'd without
" the Friction of any Part, and conſequently, the whole
" Power which draws the Rope N, is employ'd with-
" out any Hindrance; which cannot be in other En-
" gines.

" It may be objected that the Power which acts at
" N, muſt, beſides the Weight, raiſe alſo the Axel and
" great Wheel, and that their Weight is one of thoſe
" Obſtacles which *Ariſtotle* ſays all Engines are lia-
" ble to; and that this Obſtacle is equivalent to the
" Friction which is in other Organs. But it may be
" anſwer'd, That Friction is an Obſtacle wholly una-
" voidable in all other Organs; but that it is eaſy to
" remedy the Obſtacles of this, which is done by
" Means of the heavy Body M, taken equal in Weight
" to the great Wheel and Axel, which it ſuſtains by
" Means of the Rope I I, which running over the
" Pullies L L, is fix'd to the Ring or Collar K, that
" goes round the Axel F. For the Axel and the

" Wheel

" Wheel being counterpois'd by this Weight, the Power
" which acts by drawing the long Rope N, acts for
" raiſing the Weight only. The Experiment which
" was made with this Engine has confirm'd the Truth
" of this Problem, by comparing its Effects with thoſe
" of a Crane, in which the Proportion of the Bigneſs
" of the Axel to the Circumference of the Wheel,
" was the ſame as in my Machine: For it happen'd
" that in the Crane, a Weight of One hanging at a
" Rope going about the Wheel, drew up a Weight of
" Seven, when it had one Half added to it to make it
" preponderate, or give Motion to the Power: And
" when the Weight to be rais'd, and the Weight which
" ſerv'd as a Power, were proportionably encreas'd,
" there was alſo a Neceſſity to encreaſe the additional
" Weight, which made the Power preponderate, in the
" ſame Proportion: So that as it was requir'd to add
" one Half to the Power when the Weight was Seven;
" the Addition to the Power became One for a Four-
" teen Pound Weight, Two for a Twenty-eight Pound,
" Four for a Fifty-ſix Pound, and ſo on; becauſe
" the Reſiſtance from Friction encreaſes nearly in the
" ſame Proportion that the Weights are encreas'd.
" But this did not happen to my Engine, in which one
" Quarter was always ſufficient for the Draught (or
" to make the Power preponderate) not only when
" the Weight was Seven, but alſo when it was Four-
" teen Pound, Twenty-eight Pound, Fifty-ſix Pound,
" *&c.* which evidently ſhews, that this Engine acts
" without Friction."

Thus far Monſ. *Perault*. But however plauſible this Deſcription may appear, a little Attention will ſhew, that if this new Engine had no Friction, yet it is

more

more inconvenient than an *Axis in Peritrochio* with the ſame Proportions; and likewiſe that it has more Friction than the ſame Machine in the common Uſe. A C E, (Fig. 2.) is a common *Axis in Peritrochio*, which has the Wheel A E five Times bigger in Diameter than the Axel; ſo that A C, the Radius of the Wheel (which is the Diſtance of the Power) is to C B the Radius of the Axel (the Diſtance of the Weight) as 5 to 1: Conſequently One (for Example one Ounce, as in our Experiment) will keep five in Æquilibrio. Now though the Friction of the Gudgeon at C is unavoidable, yet it may be diminiſh'd by diminiſhing the Diameter of the Gudgeon, provided it remains ſtrong enough to ſuſtain the Machine and its Burthen. Here one Penny-weight, or $\frac{1}{10}$ of the Power added to it, makes it preponderate, and give the Machine Motion with a due Velocity.

Now this very Engine made uſe of in Monſ. *Perault*'s Way, does ſo alter the Diſtances of the Weight and Power, that inſtead of One for our Power, we muſt have Two and a half to keep the very ſame Weight Five, in Æquilibrio, as may appear by a Sight of the third Figure, where, ſince in the Action of the Machine, when we pull the Rope P A, we make the Axel D B to wind itſelf up upon the Rope H D, it is evident that D is now become the Center of Motion, D B (the whole Thickneſs of the Axis) the Diſtance of the Weight $= 2$; and the Diſtance of the Power is reduc'd to A D $= 4$. So that if two Men, having been employ'd in the common Way to raiſe Weights equal to the Strength of ten Men, an Engineer ſhould alter the Manner of working, and fit up the *Axis in Peritrochio* in Monſ. *Perault*'s Way, inſtead of gaining an

an Advantage, he muſt call in three more Men to perform the Work. If it be anſwer'd, that what is loſt in Strength, will be gain'd in Time, it may not only be ſaid, that one cannot always call in more Help on the ſudden, but that even then, tho' we ſhould not call this an Inconveniency, yet there will be ſtill more Friction in this than in the common Method; for the Roller or Axel will find a Difficulty to wind on the Ropes, becauſe they are not perfectly pliable, and the leſs ſo, the greater the Weight is that ſtretches them. This, together with the Friction of the Collar of the Rope of the Counterpoiſe to the Engine, makes the Hindrance greater than in the common Way. For it appears by Experiment, that when the Power is become equal to $2\frac{1}{2}$ to keep the Weight 5 in Æquilibrio, there muſt be added $\frac{1}{5}$ (here 4 Penny-weight) to put the Power in Motion.

And to ſhew that this Friction of the Ropes is not always the ſame as Monſ. *Perault* ſuppoſes it; when P (or the Power) is made only one Ounce, and W (or the Weight) two Ounces, then to make the Power preponderate, only 2 Penny-weight and 18 Grains was ſufficient. N. B. When P is $= 2\frac{1}{2}$, and W $= 5$, the additional Weight mark'd $\frac{1}{5}$ was 4 Penny-weight and 2 Grains.

It is plain from this, that Monſ. *Perault*'s Experiments were very inaccurately made, and therefore not to be depended upon.

III. *A farther Examination of the Machine's ſaid to be without Friction. By the ſame.*

AT the laſt Meeting of the Society, I ſhew'd the Inconveniency of Monſ. *Perault*'s new kind of *Axis in Peritrochio*, or Roller fix'd into a large Pully; ſhewing not only, that by the Uſe of this Engine we muſt loſe Force, whoſe Value is ſeldom to be recompens'd by the Time we gain, but alſo that the Stiffneſs of the additional Ropes which wind about the Roller, in the Operation, gives more than double (ſometimes than triple or quadruple) the Friction of the ſame Engine us'd in the common Way, when the Pivot, or Iron Axis, is in Diameter the twelfth Part of the Diameter of the Roller, or wooden Axel.

But as ſome have endeavour'd to render this Engine more uſeful, by cauſing it to roll up an inclin'd Plane, inſtead of making it riſe directly up in the Manner deſcrib'd, and condemn'd in my former Paper; I thought proper to ſhew here what muſt be the Loſs of the Power in Proportion to the Inclination of the Plane.

I ſay therefore, that in every Inclination of the Plane, if the Sine of the Angle of Inclination be taken in Parts of the Radius of the Axel, or Roller, the Power will be to the Weight :: as the Radius of the Roller + the Sine of Inclination, to the Radius of the Wheel — the ſaid Sine of Inclination; that is, in the Figure, P (= 1) : W (= 3) :: *d k* : *a k*. (See Fig. 4.)

In

In the preſent Experiment B E is an inclin'd Plane, on which the Roller C is to roll up, touching the ſaid Plane at the Point *c*; A M is the Wheel behind that Plane, another ſuch Plane, and equally inclin'd, being alſo ſuppos'd, behind the Wheel, to ſupport the other End of the Roller.

The Lines of Direction of the Power and Weight being *a* P and *d* W, through the Point of Contact, or Center of Motion, *c* draws A D parallel to the Horizon, and perpendicular to *a* P and *d* W; through the Center of the Engine, C draws *a d* Parallel to A D. Suppoſe the Angle B *c* A of the Plane's Inclination to be 30°, the right Sine will then be equal to half the Radius; therefore dividing C 2 (the Radius of the Roller) into two equal Parts at *k*, if you draw *k c* and *C c*, the Angle *k c* C will be equal to B *c* A, and its Sine will be C *k*. Now ſince it is evidently the ſame thing to make uſe of *a d* for a Lever, whoſe Center of Motion is at *k*, as of A D equal and parallel to it with its Center of Motion at *c*; it follows that in this Inclination of the Plane, the Diſtance of the Weight *d k* is greater than *d* C (the Diſtance of the Weight in the common Uſe of this Engine) by the Addition of the Quantity C *k*, the Sine of the Angle of Inclination; and *k a*, the Diſtance of the Power is leſs than C *a* (the Diſtance of the Power in the common Way) by the Subtraction of the ſaid Quantity or Sine C *k*: conſequently that on an inclin'd Plane; the Power is to the Weight :: as D *c*: to *c* A. Q. E. D.

Corollary I.

Hence it follows, that the Radius of the Wheel, and the Radius of the Roller being given, the Loſs

of Power may be found in any Inclination of the Plane. Thus, as here, the Power, which in the common Way wou'd be but $\frac{1}{5}$ of the Weight, muſt be $\frac{1}{3}$ Part of it: So if the Angle of the Plane's Inclination was but 11° 32′ the Power would be $\frac{1}{4}$ of the Weight, *&c.*

COROLLARY II.

Hence follows alſo, that if the Plane B E be Horizontal, no Force of the Power will be loſt, becauſe $cg : cf :: CG : CF$.

SCHOLIUM.

As the Friction of the winding of the Ropes, ſuch as B *c* in the new Way, is greater than the Friction of the Pivot in the old Way (beſides the Friction of the Collars of the Counterpoiſe to the Engine) ſo that Friction diminiſhes, as the Ropes bear leſs Weight, according to the Diminution of the Angle of the Plane; and when the Plane is horizontal, and without a Counterpoiſe, even then the winding up of the Ropes, and Preſſure of the Roller againſt the Plane, is equal to the Friction in the common Way.

N. B. The Experiment is made here with Pivots twelve times leſs in Diameter than the Roller, and fine pliable Silk, inſtead of Ropes.

IV. DE EQVVLEO:

Auctore Joanne Wardo, *Rhet. Prof. Greſh. et R. S. S.*

IN quem finem equuleus primo inſtitutus fuerit, et ad quem uſum adhibitus, ex multis veterum ſcriptorum locis ſatis manifeſto conſtat. Formam autem atque fabricandi rationem cum nemo eorum deſcripſerit, in varias de hac re ſententias, eaſque haud parum a ſe invicem diſcrepantes, doctiſſimi homines abierunt. Neque hoc mirum profecto ei videbitur, qui quam difficile haud raro ſit de rebus per multa ſecula deſuetis, et a conſpectu remotis, certi aliquid ſtatuere, ſecum perpenderit; idque praeſertim ſi antiqui auctores, qui eas commemorant, leviter tantum id faciant, nec plene deſcribant. Quod cum equuleo, ut dixi, evenerit; nec ullus eruditorum, qui poſt renatas literas hanc machinam nobis explicare ſuſcepit, rem adeo feliciter expediiſſe mihi videretur, ut deſcriptio cum iis, quae veteres de illa tradunt, per omnia congrueret; certius atque exploratius aliquid aſſequendi ſpem omnem prorſus abjeceram. Ceterum inter chartas quaſdam Roma tranſmiſſas, in quibus variae imagines antiqui operis, jam illic extantes, delineatae ſunt, quas vir eruditiſſimus, et Medicus Regius, RICHARDUS MEADIUS, haud ita pridem mihi conſpiciendi copiam praebere dignatus eſt, in unam forte fortuna incidi, a marmore anaglyptico in palatio Principis *Burgeſii* adſervato deſcriptam; quae, ut ſtatim conjectabar, hominem in equuleo ſuſpenſum exhibuit. Hujus igitur uſu mihi

mihi perhumaniter conceſſo, rem totam attentius conſiderare; loca apud veteres ſcriptores, in quibus equulei mentionem faciunt, ſtudioſius exquirere; et cum hac imagine diligenter conferre coepi: unde tandem evenit, ut non ſolum omnes, qui ſeculis recentioribus de equuleo tractaverant, a vero aberraſſe, ſed et cauſas quoque errorum, ut mihi videbatur, plane perſpexerim. Quorum utrumque ex iis, quae de antiqua hac machina jam dicturus ſum, ni fallor, manifeſto apparebit.

Equuleus igitur, ſi ad vocis originem attendamus, *pullum equinum*, vel *parvum equum*, ſignificat, ut ex his Tullii verbis intelligimus: *Chryſippus omnia in perfectis et maturis docet eſſe meliora; ut in equo, quam in equuleo* [a]. Atque hinc formam, pariter ac nomen, machina, de qua agimus, primo accepit.

Equuleum autem cum *cruce* nonnulli minus recte confuderunt. Crux enim patibulum fuit, cui ſervi affixi, aliique abjectae conditionis homines, ultimo ſupplicio afficiebantur. In equuleo autem quaeſtiones vi tormentorum habebantur ad crimina eruenda. Sic Val. Maximus de ſervo quodam meminit, qui ſexies in equuleo tortus culpam pernegavit; et nihilominus a judicibus poſtea damnatus, et in crucem actus eſt [b]. Nec forma igitur, nec fine inſtituto, equuleus cum cruce conveniebat.

Inter varias autem de equuleo ſententias duas tantum, utpote quae propius ad veritatem accedunt, hic memorabo. Altera eſt Hieron. Magii (quem ſequitur Gallonius [c]) qui *ad equi imaginem* factum recte judicavit [d];

[a] De N. D. l. 2. c. 14. [b] L. 8. c. 4. [c] De SS. Martyrum cruciat. c. 3. [d] De equul. c. 1.

altera

altera vero eſt Caraccioli, qui *ſtipitem erectum* fuiſſe haud minus recte cenſuit[a]. In eo autem utrumque lapſum eſſe (ut de aliis erroribus taceam) quod unam ſemper formam habuiſſe exiſtimaverint, jam demonſtrare conabor.

Seculis igitur antiquioribus equuleum ad equi imaginem quodam modo fabricabant, dorſo in eam longitudinem ac latitudinem complanato, ut hominem in illud porrecto corpore impoſitum ſatis convenienter capere poſſet. Qui torquendus enim erat, non inſidebat, ſed brachiis ſub equulei pectore retortis, vinctis manibus, pedibuſque protenſis, jacebat ſupinus. Duabus etiam trochleis diverſae magnitudinis equuleum inſtruebant; quarum minor inter clunes in hunc finem excavatos, major vero, eademque manubriata, ſub ventre collocabatur. Tortor autem cum utrumque pedem funiculis vel nervis (qui *fidiculae* dicebantur) ligaſſet, hos deinde contorquens, ac per trochleam minorem ducens, majori affixit; tum majorem hanc trochleam manubrio circumagens corpus eo uſque extendere potuit, dum artus atque oſſium compagines haud ſine maximo dolore luxarentur.

Jam veterum ſcriptorum teſtimonia, quibus haec deſcriptio confirmari poſſit, proferemus. Formam igitur equinam ratio nominis (ut ſupra obſervatum fuit) aperte ſatis indicare videtur; ſicut apud nos hodie ſimile quoddam inſtrumenti genus, quod vocamus *the wooden horſe*, ad poenas militares adhibetur. Idem quoque locutiones iſtae declarant, quae ab equo deſumtae de equuleo pariter uſurpantur. Ita non tantum *conjici*, et *imponi*, ſed etiam *ire in equuleum*, apud

[a] Apud Ferrar. Elect. l. 1. c. 5.

Cice-

Ciceronem legimus [a]. Atque hinc Pomponii jocus in verſibus Atellanicis :

Et ubi inſilui in cocleatum equuleum,
Ibi tolutim tortor [b].

Ubi voces *inſilire* et *tolutim* ab re equeſtri aperte traxit poeta. Porro cum *cocleatum* [legerem *trochleatum*] equuleum dicit, cocleis vel trochleis fuiſſe inſtructum oſtendit. Homines autem in equuleo jacere ſolitos docet Seneca, cum ait : *Hoc nobis perſuadere conaris, nihil intereſſe, utrum aliquis in gaudio ſit, an in equuleo jaceat* [c]. Quin et fidiculis corpus fuiſſe extenſum teſtis eſt Fabius, apud quem pater, quod filium torquendo occiderat accuſatus, ita loquitur : *An tu quaeſtionem illam fuiſſe credis, qualis vernilibus corporibus adhibetur ? Ideo enim equuleum movebam artifex ſenex, tendebam fidiculas ratione ſaevitiae, ut leniter ſedibus ſuis emota compago per ſingulos artus membra luxaret* [d]. Unde etiam Seneca hominem in equuleo *longiorem fieri* dicit [e]. Atque ut ea de cauſa manus pedeſque adſtringi neceſſe erat ; ſic illa, qua diximus, ratione id factum fuiſſe infra oſtendemus. Huic autem equulei deſcriptioni, quod de Zenone philoſopho traditur, adprime convenire videtur. Is enim, *cum a Nearcho tyranno torqueretur, doloris victor, ſed ultionis cupidus, eſſe dixit, quod eum ſecreto audire admodum expediret ; laxatoque equuleo, poſtquam inſidiis opportunum tempus animadvertit, aurem ejus morſu corripuit, nec ante dimiſit, quam et ipſe vita, et ille corporis parte privaretur* [f]. Jam homo in equulei dorſum, ut ſupra explicuimus, ja-

[a] Tuſc. Qu. l. 5. c. 5. [b] Apud Non. in voc. *tolutim*. [c] Epiſt. 66. [d] Declam. 19. [e] Epiſt. 67. [f] V. Max. l. 3. c. 3.

cens

cens tanto ſpatio ab humo diſtabat, ut ori ipſius alius commode ſatis aurem applicare poſſet; ideoque cum fidiculas tortor laxaſſet, attractis parum pedibus, et capite inflexo, aurem ejus morſu facile corriperet.

Porro veriſimile videtur aeneum taurum, quem confecit Perillus, et Phalaridi obtulit, hinc ortum ſuum habuiſſe. Ab hoc enim crudeliſſimo tyranno homines τρεβλᾶσθαι ſolitos teſtantur Plutarchus [a] et Aelianus [b]; qua voce Aelianum *equulei extenſionem* intellexiſſe ipſe alibi oſtendit [c]. Sic in Gloſſar. Philoxeni, τρεβλωτὴς *equuleus*. Cum peritus igitur iſte ſceleris artifex, Perillus, homines in equuleo tortos gemitibus ſuis et ejulatibus ſonitum, taurorum mugitui non prorſus abſimilem, edere obſervaſſet; quo artis adjumento res quam proxime adſimilari poſſet, de equina effigie in taurinam mutanda, hominibuſque ei includendis primum cogitaſſe haud abſurde credatur.

Ceterum equina iſta ſpecies non ſemper, ut diximus, equuleo permanſit; ſed poſteris aetatibus in aliam longe diverſam fuit mutata. Forma autem converſa, ut idem nomen retineret, huic machinae cum multis aliis rebus fuit commune. Nam, ut alias omittam, machina iſta bellica, quae ab arietini capitis ſimilitudine *aries* dicebatur, non eam perpetuo ſpeciem habuit, unde ab initio nomen accepit [d].

Equuleus igitur hiſce temporibus ſtipes erat in altum erectus; cujus ſummae parti lignum tranſverſum, atque cornuum more utrinque curvatum, impoſitum eminebat. Duplici etiam trochlea, ut prior iſte, inſtruebatur; minori imae parti ſtipitis, ad eam recipiendam excavatae, inſerta; ac majori manubriata, pone-

[a] Parall. c. 39. [b] Var. Hiſt. l. 2. c. 4. [c] Apud Suid. in voce τρεβλᾶσθαι. [d] Vid. Lipſ. Poliorcet. l. 3. dial. 1.

que affixa. Torquendus autem homo in equuleum sublatus, brachiis in lignum transversum retortis, manibusque post tergum stipiti devinctis, pendebat; fidiculis etiam pedes ligabantur, quas per trochleam deinde minorem transmissas major aversae equulei parti affixa recipiebat, cujus circumactu corpus extendebatur.

Cum de hac autem equulei specie veteris ecclesiae scriptores, qui martyrum acerbissimos cruciatus sub Romanis imperatoribus literis consignarunt, saepissime mentionem faciant; eorum potissimum testimoniis utemur in forma illius demonstranda. *Stipitem* inter alios S. Hieronymus appellat [a]. Item Prudentius:

Jubet amoveri noxialem stipitem [b].

Atque in altum fuisse erectum ex eo apparet, quod torti homines in illo *suspendi* ac *pendere* dicebantur; ut ex Eusebii & Prudentii verbis mox adducendis videbimus. De ligno transverso nihil apud antiquos auctores invenio; quod multis eruditorum allucinationibus in hac machina describenda causam dedisse, fas est suspicari. Sed in imagine, quam infra delineatam exhibebimus, lignum illud bicorne plane conspicitur. Trochleis quoque instructum fuisse, ex illis Eusebii verbis colligi potest: *Quidam, manibus post tergum revinctis, ad stipitem suspendebantur, ac membrum unumquodque* μαγγάνοις *quibusdam distendebatur* [c]. Ubi vocem μαγγάνοις, quae machinae cuicunque fere nervis aut manubrio instructae convenit, plurali numero adhibens, trochleas significare videtur. Porro ut manus post tergum

[a] Epist. ad Innoc. 49. [b] Περὶ στεφ. Hymn. 10. v. 114. [c] Hist. Eccles. l. 8. c. 10.

vinctas

vinctas fuiſſe hic docet Euſebius; ſic brachia retorta memorat Prudentius, ubi judicem ita imperantem inducit:

Vinctum retortis brachiis
Surſum ac deorſum extendite,
Compago donec oſſium
Divulſa membratim crepet [a].

Item pedes vinciri ſolitos ex alio ejuſdem poetae carmine apparet, in quo martyr ex equuleo ſic loquitur:

Miſerum putatis, quod retortis pendeo
Extentus ulnis, quod revelluntur pedes [b].

Quo pedes autem revelli poſſent, prius adſtringi debebant. Ex utriuſque etiam ſcriptoris verbis ſtipitem, ut diximus, erectum fuiſſe apparet. Atque hinc judex *ſurſum ac deorſum* eodem tempore corpus extendi jubet. Etenim hac corporis poſitione, dum pedum revulſu inferiores ejus partes deorſum extenderentur, humeros tranſverſo ligno ſuffultos, nexuque manuum ad ſtipitem repreſſos, ſurſum protrudi atque luxari neceſſe erat. Et quia ab humo elevati pendebant, hinc apud Sozomenum praeſes Chriſtianum hominem in equuleo torquendum ἀἰωρεῖσθαι, *ſublimen tolli*, praecipit; cui is, latera nudans, non opus eſſe inquit, ut lictores ipſum in equuleum levando, ac poſtea deponendo, fruſtra defatigentur [c]. Imo quo poenae conſpectiores eſſent, equuleos in cataſta fuiſſe conſtitutos, haud male ſenſiſſe videtur Ferrarius [d]; de qua martyris verba apud poetam, jam ſaepius laudatum, intelligi poſſe obſervat:

Emitto vocem de cataſta celſior [e].

[a] Ubi ſupra, Hymn. 5. v. 109. [b] Ibid. Hymn. 10. v. 491. [c] Hiſt. Eccleſ. l. 5. c. 2. [d] Elect. l. 1. c. 6. [e] Ubi ſupra, Hymn. 10. v. 467.

Quibus et illa, ni fallor, ejuſdem carminis adjungi poſſint:

Incenſus his Aſclepiades juſſerat
Eviſcerandum corpus equuleo eminus
Pendere [a].

Cataſta autem pegma vel tabulatum eſt, in quo apud nos quoque ii collocantur, quibus *numellae* poena infligitur. Sigonium [b] igitur, alioſque viros doctiſſimos, cataſtam de ipſo equuleo perperam accepiſſe cenſet Ferrarius. Et revera, ni equuleus in cataſta collocatus eſſet, qua ratione *corpus* in eo *eminus pendens* tortores ungulis ſuis ferreis *eviſcerare* poſſent? Proinde fidiculas ad corpus extendendum in hac forma equulei, aeque ac priori, adhibitas fuiſſe, ex Codice Juſtiniani diſcimus; ubi Valentiniani imp. edicto *decuriones exſortes omnino earum eſſe poenarum, quas fidiculae et tormenta conſtituunt*, jubentur [c]. Hiſce autem verbis equuleum veteres haud raro deſcribere ſatis notum eſt.

Jam ſi verba et locutiones, quae diverſis temporibus equuleo tributa ſunt, paulo attentius conſideremus; eidem formae nequaquam congruere, neceſſario fateri cogemur. Primum enim ex novo adjecto nomine formae mutationem colligere licet. Nam vox *ſtipes* machinae ad equi imaginem factae nullo modo convenire potuit. Quare aut effigiem equinam, contra certam vocis *equulei* interpretationem, ac veterum locutiones ab illa deſumtas, nunquam habuiſſe dicendum eſt; aut cum ſtipes deinceps vocari coepit, aliam formam accepiſſe. Praeterea antiquius *jacere*, poſtea vero *pendere* et *ſuſpendi* in equuleo

[a] Verſ. 108. [b] De Judic. l. 3. c. 17. [c] L. 16. de quæſt.

homines

homines dicuntur ; qui duo corporis ſitus, tam longe diverſi, formam machinae haud minus diverſam requirunt. His accedit, quod alteri formae alterum effectum adſcribi videtur. Vetuſtioribus enim ſeculis corpus ſimpliciter *extendi* dicitur, utpote in planum porrectum ; ſequentibus vero aetatibus *ſurſum ac deorſum*, quod pendenti convenit, id fieri jubetur. Denique in priori equuleo homo decumbens ea fuit altitudine, ut in aurem alicui ſuſurrare poſſet ; quod in poſteriori ſuſpenſo propter nimium a ſolo ſpatium haud omnino congruit. Et quis jam non videt hanc verborum ac locutionum diſcrepantiam ad duplicem equulei ſpeciem neceſſario referendam eſſe? Certe homines iſti eruditi, qui aliter ſenſerunt, dum omnia apud veteres de hac re loquendi genera ſententiae ſuae accommodare conati ſint, eis difficultatibus fuerunt impliciti, unde nullo modo ſeſe explicare potuerunt.

Verum ne qua hoc in dubium vocandi anſa in poſterum reſtet, duo teſtimonia ex iis temporibus, quibus ſtipitis formam equuleo ſupra tribuimus, a Gallonio in contrarium allata [a], breviter diluemus. Alterum ex illis S. Hieronymi verbis petitur: *Cum equuleus corpus extenderet, et manus poſt tergum vincula cohiberent* ; *oculis, quos tantum tortor alligare non poterat, ſuſpexit ad caelum* [b]. Ex quo loco neceſſe eſſe, ut in equuleo torti corpore proſtrati jacerent, contendit Gallonius. At nemo non clare perſpiciet, hominem eo modo, quo diximus, ſuſpenſum, aeque facile *ad caelum ſuſpicere* poſſe, ac ſi corpore ſupino jaceat. Alterum teſtimonium ex

[a] De SS. Martyr. cruciat. c. 3. [b] Epiſt. ad Innoc. 49.

Amm.

Amm. Marcellino adducitur: *Innocentes tortoribus expoſuit multos, vel ſub equuleo cepit* [rectius Valeſius *caput*] *incurvos, aut ictu carnificis torvi ſubſtravit* [a]. Et alibi: *Quanquam incurvus ſub equuleo ſtaret* [b]. Unde idem vir doctus novum quoddam et inauditum cruciandi genus excogitavit; quaſi tortores nonnunquam doloris augendi gratia, laxatis funiculis, corpus ſub ventrem equulei cadere, atque ibi incurvatum pendere ſinerent. Verum non *ſub equuleo cecidiſſe* vel *pependiſſe* dicit Ammianus, ſed *ſtetiſſe*: quod qua ratione cum Gallonii ſententia convenire poſſit, non intelligo. Sed quia mos fuit eos, qui in equuleo torquendi erant, prius flagellis verberari, *incurvus* fortaſſe dixit, quod verberibus laceratus recto corpore ſtare amplius non potuit; idque *ſub equuleo*, hoc eſt, juxta equuleum; ut cum dicitur, *ſub haſta venire* [c]: quod de voce etiam *incurvos* in altero Ammiani exemplo pari ratione dici poteſt. Ni quis potius de catenis onuſtis, earumque pondere incurvatis, voces iſtas intelligere malit; quemadmodum et in re ſimili ſcribit Paulinus Aquitanus:

Moeſtorum pallens infelix ordo reorum
Haerebat, nexis per ſqualllida colla catenis,
Incutiens fractis ſtridentia vincula membris,
Et motans tardos, incurvo pectore, greſſus [d].

Hic voces *incurvo pectore* eodem ſenſu, quo Ammianus *caput incurvos*, uſurpaſſe videtur. Nonnullos etiam ex hoc infelici ordine equuleo deſtinatos fuiſſe poſt pauca ſignificat.

[a] L. 26. c. ult. [b] L. 28. c. 1. [c] Liv. l. 5. c. 16. [d] De vit. B. Martini l. 5. v. 261.

Aſt alii ſurſum porrecti robora ligni,
Triſte miniſterium, furioſo corde parabant;
Ut caro diſtentis propere, male pendula, membris
Tortori laceros cruciandа exponeret artus.

Ubi etiam verba *ſurſum porrecti robora ligni*, et *caro pendula*, erectam equulei formam plane demonſtrant.

Ceterum cum neque verberibus, neque membrorum extenſione, ut rem quaeſitam confiteretur, homo tortus evinci potuit; ignes et ardentes laminae aevis antiquioribus corpori admovebantur. Ita Fabius, rem totam ordine recitans: *Ego ſcindo veſtes, tu intremiſcis; ego ad flagella nudo corpus, te facit pallor exanimem; ego equuleos, ego poſco flammas; tu non habes in meo dolore patientiam* [a]. Et V. Maximus: *Rupit verbera, fidiculas laxavit, ſolvit equuleum, laminas extinxit; priuſquam efficere potuit, ut tyrannicidii ſocios indicaret* [b]. Sequentibus autem ſeculis, cum jam ſtipitis ſpeciem equuleus receperat, hiſce omnibus torquendi modis ungulae etiam ferreae adjiciebantur, quibus latera et aliae corporis partes laniari ſolebant. Sic in Codice Juſtiniani praecipitur: *Si convictus fuerit, et ad proprium facinus detegentibus repugnaverit pernegando, ſit equuleo deditus, unguliſque ſulcantibus latera perferat poenas proprio dignas facinore* [c].

Attamen quo tempore haec formae immutatio inter Romanos fieri coeperit, pro certo affirmare nequeo. Ad Fabii ſaltem aetatem, hoc eſt, imperium Domitiani, ſpeciem manſiſſe equinam eo credibile videtur, quod pater, qui in Declamatione ſupra citata ob fili-

[a] Declam. 7. [b] L. 3. c. 3. [c] L. 7. de malefic.

um

um a ſe tormentis occiſum defenſionem ſibi inſtituit, tanquam *jacentem* in cruciatibus illum deſcribit. Ratio autem mutationis ſatis, opinor, probabilis adferri poteſt. Inferioribus enim Romani imperii aetatibus non tantum Chriſtianos, ſed alios etiam eximiae dignitatis homines majeſtatis crimine poſtulatos, equuleo traditos fuiſſe ſaepius legimus. Quamdiu autem in quaeſtionibus jure conſtitutis ſolum adhibebatur, nihil amplius erat neceſſarium, quam ut ea, quae a reo dicerentur, ipſi judices, aliique quorum intereſſet, exaudire poſſent; cui propoſito forma equina ſatis conveniebat. Poſtea vero cum crudeliſſimis iſtis tyrannis ad ſuſpicionibus ſuis indulgendum, atque Chriſtianos vexandum, hac machina abuti placuit, erecta forma ſine dubio omnium fuit commodiſſima. Nam ita crucis ſpeciem quodam modo referebat, quo major poenae eſſet ignominia; et praeterea homo tortus oculis circumſtantium ad alios deterrendos magis exponebatur. Apud Graecos ſane, unde Romani acceperunt, figuram equinam in uſu fuiſſe, cum Perilli taurus, tum etiam Zenonis hiſtoria ſupra memorata, manifeſto ſatis declarare videntur.

Verum enimvero ut diſcrimen inter has duas machinas clarius pateſcat, ac melius inter ſe conferri poſſint, utriuſque imaginem hic conjunctim exhibebimus.

Prior forma equulei, **A.**

Poſterior forma equulei, **B.**

Priori adſtat tortor, majoris trochleae manubrium tenens, quo hominem in dorſum equulei impoſitum extendat. Poſterior autem, quam a clariſſimi MEADII exemplari delineatam dedimus, tres humanas figuras habet

habet adjunctas ; quarum una eſt hominis in equuleo ſuſpenſi, duae reliquae ſunt tortorum. Ex his alter, chlamyde (quam veſtem tortori etiam tribuit Hieronymus [a]) ab laevo humero pone rejecta, dextrum equulei cornu dextra prehendit, quaſi recte aliquid compoſiturus ; alter vero, utpote prioris adjutor, nudus, ac genu nixus, ad pedes torquendi hominis vinciendos ſe parat. Quod ſiniſtrum autem equulei cornu dextro ſit brevius, injuria temporis accidiſſe credamus ; quia ſumma pars plane abrupta eſſe videtur. Quaedam aut ipſe artifex, aut ſaltem delineator omiſit. Etenim nec inferior pars ſtipitis, ubi conſpici poſſet, nec trochlea ad imum conſpicitur : nam alteram trochleam pone collocari ſolitam ſupra notavimus. In eo autem alteruter manifeſto erravit, quod hominem in equuleo ita conſtituerit, ut pedum digitis ſolum tangere videatur ; quod neque pendenti, neque veterum teſtimoniis de hac re ſupra adductis, omnino convenit. Sed veruſtis hujuſmodi monumentis haud raro accidere invenimus, ut partes praecipuas, et quae ſummam operis continent, artifices diligenter ac ſtudioſe effinxiſſe contenti, reliquas vel prorſus neglexerint, vel minus ſaltem accurate expreſſerint. Ceterum ne quis ea diutius fruſtra requirat, quae in exemplari deſiderantur, ſeorſim delineata oculis ſubjecimus, una cum tortore trochleam convertente. Arcus autem, qui juxta hominis ſuſpenſi caput ſiniſtrorſum conſpicitur, nihil cum equuleo habet commune ; ſed oſtii alicujus partem, carceris forſan unde productus fuit, exhibet.

Jam ſi duplicem hanc equulei formam, ac ſingulas partes inter ſe conferamus, eundem plane torquendi

[a] Ubi ſupra.

modum ſub diverſa ſpecie utrique fuiſſe facile videbimus. Si priorem enim, ad equi imaginem factam, in altum modo erectam mente concipiamus ; trochleae, fidiculae, retorſio brachiorum, et totius corporis extenſio, haud aliter atque in poſteriori conſtitui apparebunt. Praeterea nihil difficile, nihil operoſum videtur ; ſed facilis et expedita cruciandi ratio nobis ſe offert, quae in publicis ſuppliciis praecipue requiritur.

At nequis poſt omnia, quae hactenus dicta ſunt, *furcam*, hoc eſt, *crucem* ad furcae imaginem factam, pro equuleo nos protuliſſe ſuſpicetur ; ſciendum eſt hanc equulei ſpeciem furcae non admodum fuiſſe diſſimilem. Hoc Theophili cujuſdam verba, a Gallonio plane contra ſententiam ſuam allata, demonſtrant : *Ecce*, inquit, *modo Chriſtianus ſum, quia in cruce, id eſt in equuleo, ſuſpenſus ſum. Equuleus enim crucis quandam ſimilitudinem gerit* [a]. Nihilominus tamen furca in multis ab equuleo differebat. Primum enim ima pars cornuum ad formam V literae in acumen coibat ; deinde cornua multo erant longiora ; praeterea, qui in furcam agebatur, brachiis ſupra caput, non poſt tergum, retortis pendebat ; denique manus haud ſtipiti conjunctae, ſed cornibus diſpanſae ligabantur, ut oſtendit Lipſius [b]. Et tamen alibi vir idem eruditiſſimus Auſonii verba de *Cupidine torto* cruci aſſignat [c], quae ad equuleum omnino referri debent. Locus Auſonii ita ſe habet :

Hujus in excelſo ſuſpenſum ſtipite Amorem,
Devinctum poſt terga manus, ſubſtrictaque plantis
Vincula moerentem, nullo moderamine poenae
Adfligunt [d].

Cum poeta hic ait, *devinctum poſt terga manus*, non crucem, ſed equuleum plane deſcribit. Porro cum

[a] De SS. Martyr. cruciat. c. 3. [b] De cruce, l. 3. c. 6. [c] Ibid. l. 1, c. 5. [d] Edyll. 6.

Sulpicius Severus de B. Martino loquens ait, gloriam martyris eum adeo affectasse, ut, si licuisset, *equuleum sponte ascendisset* [a]; machinae figura ac ratio suspensionis, quemadmodum id facere potuisset, aperte satis ostendunt: in furca autem se ipsum nemo suspendere potuit.

In summa autem, cum tota hujusce rei probatio veterum scriptorum testimoniis praecipue nitatur, ut plura adferre, quae haud parva copia sese obtulerunt, supervacaneum duximus; ita nec pauciora ad plenam ejus explicationem sufficere existimavimus. Verum quaecunque de ea apud antiquos leguntur, uni aut alteri speciei supra descriptae facile tribui possunt. Qui ad auctoris igitur aetatem, et diversos loquendi modos diversis temporibus de equuleo usurpatos attenderit; nihil, opinor, difficultatis in posterum inveniet, quid de hoc tormenti genere statuere debeat; in quo explicando tot viri eruditi hactenus se frustra torserunt.

[a] Epist. 2.

V. *An Account of a Treatise entituled,* Calculations and Tables relating to the attractive Virtue of Loadstones, *&c. Printed* Anno 1729.

THE Author, (the Hon. Lord *Paisley*) by several Experiments very carefully made, has observed, that if two Loadstones are perfectly homogeneous, that is, if their Matter be of the same specifick Gravity, and of the same Virtue in all Parts of one Stone, as in the other, and that like Parts of their Surfaces are cap'd or arm'd with Iron, then the Weights they sustain will be as the Squares of the Cube Roots of the Weights of the

Loadſtones; that is, as their Surfaces. Upon this Principle the Tables are formed. The firſt Column of theſe Tables is in common to the four following, and helps to ſhew how many times its Weight any Loadſtone ſuſtains.

In the ſecond, third, fourth and fifth Columns, are the Weights of Loadſtones in different Denominations. The ſecond, entituled Grains, reaches Grain by Grain to 480 Grains, or one Ounce, and will ſerve for any Loadſtone, whoſe Weight does not exceed one Ounce. The third reaches, by Penny-weights, up to two Pounds, or 480 Penny-weights, and therefore ſerves for any Stone that weighs not leſs than one Penny-weight, nor more than two Pound. The fourth Column reaches, by Ounces, up to forty Pounds, or 480 Ounces, and therefore will ſerve for any Stone not exceeding that Weight. The fifth ſerves from one to 480 Pounds. The ſixth Column entituled, Weight ſuſtained, is in common to the four preceding; and the Numbers in this Table, if they were divided by 10, would be the Squares of the Cube Roots of the Numbers in natural Order, from 1 to 480, as they are found in the Column of Pounds. But theſe Squares of the Cube Roots are here multiplied by ten, becauſe a Loadſtone of the very worſt Sort, if it weighs but one Grain, will ſuſtain ten Grains; and ſo theſe Tables, by ſimple Inſpection, ſhew what Number of Grains any Loadſtone of that worſt Character would ſuſtain, if the Stone weigh not more than 480 Grains, or one Ounce. The Numbers in the firſt Column entituled, How often its Weight, are proportional to the Reciprocals of the Cube Roots of the natural Numbers, and are form'd by dividing the Numbers of the ſixth Column, by

the

the correſponding natural Numbers, as they are found in the Column of Pounds.

For the greater Convenience of Calculation, his Lordſhip has added Tables; firſt of Decimal Parts for Penny-weights, Ounces, and Pounds, in order to loſe as little as poſſible of the Fractions, in the ſeveral Calculations. The next are Tables of Grains, Penny-weights, Ounces, and Pounds, which readily ſhew how many of each Denomination are contained in the others. The Tables entituled, From Grains to Penny-weights, &c. and the others from the ſeveral Denominations to others, are of Uſe for carrying the Computation readily from any one Denomination to another: And laſtly, the Tables at the Bottom of theſe laſt mention'd are of the like Uſe, for the ready finding the Value in Money of any Loadſtone, from the Numbers proper to Grains, to Penny-weights, to Ounces, and to Pounds.

The Honourable Author then proceeds to explain the Uſe of theſe Tables, by Inſtances under each Denomination. Thus, if a Loadſtone does not exceed one Ounce, or 480 Grains, the particular Weight of the Stone, with the Weight it ſuſtains, being known, he reduces the Weight ſuſtained to Grains, by the Help of the Table of Grains. Then looking into the Column of Grains for the Weight of the Stone, againſt it, inthe Column of Weight ſuſtained, he finds the Number of Grains, which a Stone of the worſt Sort of this Weight would ſuſtain; and then dividing the known Number of Grains which this particular Stone will ſuſtain, by the Number of Grains expreſſed in the Column, the Quotient ſhews the Character of Goodneſs in the Stone propoſed; and by the Help of this Number may be known what Weight any other

Stone

Stone of equal Goodneſs with this would ſuſtain, let its Weight be leſs or more, provided it does not exceed one Ounce, or 480 Grains. For looking into the ſecond Column for the Weight of the Stone, and having found againſt it, in the ſixth Column, the Weight ſuſtained by a bad Stone, if you multiply the Quotient above found, which ſhews the Character of Goodneſs, by the Number in the Tables expreſſing the Weight ſuſtained, the Product is the Number of Grains this particular Stone will ſuſtain.

If a Stone of the ſame Character weighs more than one Ounce, or 480 Grains, and leſs than two Pound, to know what Weight this will ſuſtain, the Computation muſt be transferred from the Column of Grains to that of Penny-weights. Now ſince one Penny-weight is equal to twenty-four Grains, and the Weight ſuſtained is to be expreſſed, not in Grains, but in Penny-weights, the former Number, which gives the Character of Goodneſs of the Stone for Grains, muſt be altered, to do the ſame thing for Penny-weights. Multiplying therefore this Number by the Reciprocal of the Cube Root of 24, the Number of Grains contained in one Penny-weight (and the Numbers in the Tables are formed accordingly) the Product gives the Number ſhewing the Character of Goodneſs in this Stone, which being found, the remaining Part of the Operation is the ſame as in the former.

If a Loadſtone exceeds 480 Penny-weights, and is leſs than forty Pound, we muſt in like manner find the Number of the Stone for Ounces; which may be done either by the Number already found for Grains, multiplying it by the Number againſt Unit in the Table from Grains to Penny-weights, or by the Number for Penny-weights, multiplying it by the Number

ber againſt Unit in the Table from Penny-weights to Ounces, and the Product is the Characteriſtick Number of this Stone. Proceeding therefore as in the firſt Inſtance, the Weight it will ſuſtain will be found.

The Column of Pounds is only uſeful where a Loadſtone's Weight exceeds forty Pound, or 480 Ounces, in which Caſe the ſame Method muſt be uſed as in the others.

To know how many times a Loadſtone will take up its own Weight, multiply the Number proper to the Denomination in Uſe, by the Number in the firſt Column (entituled, How often its Weight) which is againſt the Weight of the Stone in the Column of that Denomination.

His Lordſhip cloſes his Account with explaining the Uſe of the Tables relating to the Value of Loadſtones in Money; and this he ſuppoſes to be in the compound Proportion of the Goodneſs of the Stone, and of the Weight it ſuſtains; becauſe if two Loadſtones take up the ſame Weight, the leſſer is more valuable, as it does more in Proportion to its Bulk, and what better Rule to eſtimate the Value by, than the Goodneſs of the Stone? On the other Hand, if the Stones are in Nature equally good, but ſuſtain different Weights, it is reaſonable, that their Value ſhould be according to the Weights they ſuſtain. Both theſe Circumſtances therefore being conſidered together, in order to find the Value of any Loadſtone by the Tables, we muſt multiply the characteriſtick Number for the Stone, by the Number entituled, Value in Money, taking this Value in Money from the particular Denomination that the Stone comes under; and this Product will be the Value, *per* Ounce, of what the Stone ſuſtains. Then multiplying

tiplying this Value *per* Ounce, by the Number of Ounces the Stone ſuſtains, will give the Value in Money of the Stone propoſed.

VI. *An Account of a Book entituled,* Jo. Frider. Weidleri Obſervationes Meteorologicæ & Aſtronomicæ, Annorum 1728 & 1729, *&c.* Wittembergæ, Anno 1729.

THE Author, after dedicating his Tracts to the Royal Society, gives a Deſcription of the particular Sort of Barometer, Thermometer, Hygrometer, and Hyetometer, which he made uſe of in the ſubſequent Obſervations. The firſt of theſe is a Diary of the Weather, from the Vernal Equinox of the Year 1728, to that of the Year 1729; containing the daily State of the Barometer, Thermometer, Wind and Weather, together with the Quantity of Rain during that Time. To this he annexes ſome *ſelect* Meteorological and Aſtronomical Obſervations, which he deſcribes more at large.

The firſt he takes Notice of is a remarkable *Halo* round the Moon, on *February* 20, 1728, at forty-five Minutes paſt Seven in the Evening, when the Moon was not far diſtant from the Meridian, and about her firſt Quarter. The Diameter of the *Halo* occupied about 47 Degrees, being extended from ε in *Procyon* to *Capella* towards the Weſt. Its Arch was $4\frac{1}{2}$ Deg. broad, as far, for Inſtance, as α and ε in *Procyon* are from each other. Within it was red, and towards the Extremity was pale; exhibiting entire a beautiful

Spectacle

Spectacle for about four Minutes, but he did not know when it began. Before it diſperſed, ſome thin white Clouds began to paſs over it tranſverſly, and then it was broke towards the Weſt, the Redneſs of the diſperſing Vapours greatly encreaſing: After which the Sky became clear again. The ſame Day at Noon, he obſerved thirteen Spots on the Sun, the largeſt equalling $\frac{1}{34}$ of the Sun's Diameter; and the Spirit fell to 90 Degrees of the *Engliſh* Thermometer.

April 4, 1728, he obſerved an *Aurora Borealis*.

On *June* 20, another, which is deſcribed in the *Act. Erudit. Lipſ. Ann.* 1728. *p.* 375.

October 7, a very remarkable one appeared in the N.E. A *White Arch*, extended between the W. and N.E. quickly aſſumed a black Colour, and then divided into three other concentrical Arches equally black. From theſe ſome Radiations aroſe as uſual, but ſhorter. A little afterwards theſe likewiſe ceas'd, and the black Arches were converted into luminous Tracts, only one remained till eleven o' Clock: And whereas at firſt the lowermoſt Arch was raiſed ſeven Degrees above the Horizon, it was now depreſſed towards it, being ſcarcely two Degrees above it.

The Author next proceeds, and gives fourteen Aſtronomical Obſervations, ten of which are of the Eclipſes of *Jupiter*'s *Satellites* at different Times. In making theſe he was guided by *Caſſini*'s Tables for the Meridian of *Paris*, and by comparing the Time when they ſhould happen, as therein ſpecified, with the Time he obſerved them at *Wittemberg*, he collects the Difference of Meridians of that City and *Paris* to be 41 Minutes.

The eighth Obſervation contains his *Calculus* for the total Eclipſe of the Moon which happened *February* 13, 1729, *N. S.* but the Heavens being very cloudy, he could not obſerve the Eclipſe itſelf.

The ninth is an Obſervation of *Mercury*, *March* 4, 1729; at which Time the Planet was fartheſt from the Sun, and remained ſome Time above the Horizon. Making uſe therefore of a twenty-two Foot Teleſcope, he obſerved its Phaſe almoſt biſſected, and its Diameter appeared equal to a third Part of the Diameter of *Venus*, this Planet being above the Horizon, and ſeen at the ſame Time.

The thirteenth is a Conjunction of *Venus* and the *Moon*, *viz. April* 2, 1729. At 7 H. 13′ he obſerved *Venus* placed in ſuch manner near the *Moon*, that the Horns of the *Moon* were in the ſame right Line with *Venus*, which was then diſtant from the Southern Cuſp of the *Moon* 1 Deg. 10′. At 7 H. 30′. he meaſured the Diſtance of *Venus* from the Eaſtern Cuſp of the *Pleiades* to be 2 Deg. 15′, and the Horn of the Moon at the ſame Time was diſtant from the ſame Cuſp 1 Deg. 53′, 45″; the intermediate Diſtance of the Horns of the *Moon* was 29′ 30″.

His laſt Obſervation is on the Declination of the Magnetical Needle in this and the former Year, which he defines to be 12 Deg. 0′ 55″ Weſt at *Wittemberg*, at this Time.

Theſe Obſervations are followed by the Author's Account of the laſt hard Winter. This ſet in ſooner than uſual, the Rivers being frozen the 19th of *September*, though they uſed not to be ſo till the Winter Solſtice, and the Spirit of Wine in the *Engliſh* Thermometer, on *September* 21, fell to the 66th Degree:

At

At which Time a N. E. Wind blew very ſtrong. Afterwards, on *October* 3, the Spirit fell to 72 Deg. and the Ice was half an Inch thick on ſtanding Waters in the Fields, ſo that even then it might be judged, that the Cold would be more ſevere than is uſual in their Parts. From this Time the Froſt did not at all abate, but continued much in the ſame State the Month of *October*, except on the 20th Day, after a S. W. Wind had blow'd pretty hard for ſome Days, the Cold was obſerved to encreaſe remarkably. The Beginning of *November* a ſtrong Eaſt Wind continuing to blow for ſix Days, the Spirit ſunk to 86 Deg. on the fifth, and the Ice was much thicker. On the 28th it fell to 96 Deg. after which they had no Rain, but all Vapours were congealed into Ice and Hoar. On *December* the 2d, the Spirit of Wine ſtood at 96 Deg. but on the 4th at 99 Deg. ſo that it not a little exceeded the Limit of intenſe Cold. Hence a S. W. Wind intervening now and then, the Cold ſeemed to abate a little; but that, and ſometimes a N. E. Wind blowing ſtronger on the 21ſt, 22d, and 23d Days, it ſo prepared the Air, that on *Chriſtmas* Day the Spirit in the Thermometer ſtood at 96 Deg. and the Cold was intenſe. Hence the Winter grew immediately more ſevere. The Wind almoſt always blew from the E. or N. ſo that on *January* 20, the Cold was almoſt intolerable, on which Day the Spirit deſcended to the 126th Deg. very little remaining above the Ball of the Tube; and this was the greateſt Degree of Cold at *Wittemberg*. After this the Winter ſomewhat declined. A S. W. Wind blew freſh ſometimes; but afterwards a N. and E. Wind reſtored the Cold on *February* 3, when the Spirit ſtood again at 86 Deg. On the 4th it fell to

95 Deg. and from this Time, barring a few Days, always in a Morning it reciprocated between 80 Deg. and 100 Deg. to *March* the 8th, on which it exceeded 106 Deg. and on the 9th it was forced down by a N. E. Wind to 110 Deg. But although the Spring was at Hand, yet the Severity of the Weather did not ceaſe, as appears in that the Spirit of Wine, in the *Engliſh* Thermometer, in a Morning always ſtood at, or under the 80th Deg. of the Thermoſcopick Scale; nay, even on *March* the 21*ſt*, on which Day the Equinox preciſely fell, it was at 81 Deg. At length, on the laſt Day of *March*, the Weather grew milder, from whence may be taken the true Beginning of the Spring; not but that all *April* was much colder than uſual.

Thus far from Thermoſcopical Obſervations. After this, the curious Obſerver proceeds to ſhew its Severity from ſome of the more remarkable Effects the Cold had on the Rivers, Plants, and Animals. As to the firſt, he ſays, that the *Elbe*, both at *Wittemberg* and other Places, was covered on *December* 29, with a perfect Bridge of Ice, which bore both Men and all Sorts of Carriages. This remained till *February* 28, when it grew thinner, and broke conſiderably; but the Cold returning on *March* 8, it re-united, and was as firm as before, till *March* 29. The Water within the Houſes, and in the Bed-chambers, where were good Fires, was wholly congealed and the Rind within on the Windows ſtuck for many Days, when the Wind was either E. or N. though the Room was well warmed. Examples of the other Kinds were ſeveral. Many Perſons periſhed in their Journeys, and more loſt their Limbs in a very ſhort Time: So that near the

Elbe

Elbe they could not work abroad. It killed alſo many Animals immediately. The Crows, which can bear intenſe Cold, fell dead from the Trees: Stags, Goats, and Hares periſhed in great Numbers. The Plants likewiſe felt its Violence, and the more tender Trees were damaged. The Limes were every where injured: The greater Branches of the Plumb-trees, Apricots and Peaches, were dried up; but the Vines ſuffered moſt, the more robuſt being ſhriveled to the very loweſt part of their Trunk, unleſs guarded by a Wall, or ſome other Covering.

From theſe Obſervations the Author compares this Winter with the memorable one of 1709, and proves both from Thermoſcopical Obſervations; from its Effects upon the Earth and Animals; from its longer Continuance, and from the greater Extent of the Cold into the more Southern Parts, that this laſt much exceeded the former, at leaſt in *Germany*.

Having thus finiſhed the Hiſtory, he laſtly enquires into the probable Cauſes of it. He takes Notice, that the Winter foregoing was moderately cold and dry; and as a cold Summer ſucceeded, and alike dry, in which the North Winds blew moſt frequently, and during the hotteſt Months of *July* and *Auguſt* the Sky was covered with dark and black Clouds, the Earth was prepared for Froſt; to which the remarkable Drineſs of the Seaſon did not contribute a little, as Barometrical Experiments ſhew, that a dry Air cools ſooner than a moiſt, and is both heavier, and retains Cold longer. Neither does he think it altogether foreign to Truth, to reckon the remarkable Frequency of the *Aurora Borealis* to be a Preſage of a colder Winter than ordinary, which has been obſerved to be followed

by

by cool and ſerene Weather: As alſo the unuſual Number and Largeneſs of the Spots on the Sun's Disk, for almoſt two Years together; by which Means, in ſuch a Length of Time, the Force of its Rays might be obſtructed in ſome Degree, and the colder Winds thereby have Liberty to prevail. The Air by theſe concurrent Cauſes being rendered very cold, the Encreaſe, and extreme Degree of it proceeded from the great Cloudineſs of the Sky; and the blowing of the N. E. or E. Wind, ſo remarkably obſervable for the moſt part of the Froſt.

VII. *Occultatio Veneris à Lunâ ſubeunte* Berolini *viſa die* 19 Septembris 1729, N. S. *p. mer. à D.* Kirchio. *Ex Diario Meteorologico* (*M.S.*) J. Fred. Weidleri, *L. L. D. & Math. Prof. Prim.* Wittembergæ.

CONTIGIT Acceſſus Lunæ ad Venerem 2H. 2′ 16″. Occultatio totalis 2 H. 3′ 1″. Idem, per Teleſcopium octodecim Pedum notavit Venerem ferè in Quadraturâ poſitam, cum prope Lunæ diſcum accederet, figuram mutaſſe, & Falcis cuſpides amiſiſſe; unde Ovalis vel Elliptica figura oriebatur: Quod ſpectaculum pro comprobandâ Lunæ Atmoſphærâ laudari poſſe *D. Kirchius* cenſet.

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MDCCXXX.

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PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *March* and *April*, 1730.

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Jos. Banks

LONDON:

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MDCCXXX.

I. *Caſus Rariſſimus. Ex Epiſtolâ Doctiſſimi Viri* J. Huxham *ad* Gul. Rutty, *M. D. R. S. Secr.*

NIhil fere quam in Pelvi renali & Urinaria Veſica Calculos invenire frequentius : At quis unquam in ipſa Urethra Calculum ponderis unc. quinque cum ſemiſſe invenit? En ideo Caſum plane mirandum.

Viginti abhinc Annis Penis cujuſdam *Cookworthy* ob Luem Veneream, ad modum quaſi *Eunuchi Turcici*, reſectus fuit: at Vulnus nec probe curavit Chirurgus, nec bene ſanavit; Cicatrice quippe obducta vix ullum Urinae Iter, Urethra pene occluſa. Lotium exinde exiguiſſimo Rivulo ſummoque niſu reddidit; brevique inter mingendum Cruciatus magnus acceſſit; pauloque poſt in media, at ſuprema, Parte Scroti Tumor parvus, ſenſim tamen auctus in magnam demum excrevit molem, lævum ad Inguen quaſi vergens. Hinc Urinam ejaculandi impotens prorſus factus Stillicidio ejus continuo laboravit. Sed neque hac via, Urethrae ſcilicet, omnem emulxit; enatis enim tribus quatuorve in Scroto Fiſtulis, pars forte maxima Lotij ex hiſce defluxit, Pure ſubinde comitante. At ne ſic quidem Tumor, jam durus admodum, vel minime decreſcebat, quinimo increvit uſque.

Dira haec inter Tormenta cum per plures jam Annos Miſer hic, neglectus omnino, miſerrimam pertraxerat Vitam ad noſtrum Noſocomium tandem delatus fuit. Ibi menſe Julio elapſo, quum ſummo nixu Urinam, ſolito quod dixit ardentiorem, expellere, Corpus incurvando maxime, contenderet, ingens hic pro-

lapſus eſt Calculus, quem jam Tibi miſi; qui recens excretus Uncias quinque cum Semiſſe Ponderis Avoird. pependit. Eum mihi propere, quaſi monſtrum quoddam, mitti curabant Noſocomij Rectores. Rem certe quod debui plane mirabar Hominemque inviſebam continuo Lacerum inveni Scrotum, jam minime tumidum, Manum puerilem facile admittens, & ex Urethra Calculum elapſum fuiſſe deprehendi.

Atqui id forſan haud parum Miraculo adjiciat, quod magnum hoc lacerumque Vulnus Balſamo quodam Terebinthino tantum oblinendo brevi ſanum evaſit, ni quod parva adhuc pateat Urinae Fiſtula in ſuperiore Parte Scroti. Atque Miſellus Ille, cui ante excretionem. Calculi vix ulla ſe movendi Potentia, commode jam ſatis obambulat.

Non ego quidem hunc Calculum in Urethra primitus fuiſſe enatum autumo, ab ibidem Loci ex arenoſa materia concretum maxime. Cum enim parvus forte Calculus, Semen quaſi hujus enormis, è Renibus delapſus erat; & ob Urethram fere occluſam, negato ultra Itinere, in Canaliculo ſubſtiterat, Sabulo perpetim appellente auctus in immenſam hanc Molem tandem excrevit.

Plymouth, Id. *Febr.* 1729-30.

Caſus alter perquàm rarus ex eâdem Epiſtolâ.

Peperit nuperrime Domina quaedam Puellulam rite & eleganter ſatis conformatam, ni quod in regione Lumborum infima eminuerit Tumor, ſive Sacculus, Magnitudinis quaſi Pugni puerilis; cujus inſuper Pedes ad nates uſque retracti Poſituram Sartoris incoxantis exhibuerunt; nec eos movere ullo modo, aut extendere,

tendere, potuit. Mirum hoc & triſte Parentibus viſum eſt, mirum & obſtetrici & matronis adſtantibus : meum ideo protinus Conſilium petunt.

Tumorem hunc perluſtrando eum ejuſdem eſſe Generis cum illis, quos Tulpius, Cap. xxix, & xxx. lib. III. obſervat. Deſcripſit ſuſpicabar: iſtum ideo Fomento aromatico & adſtringente foveri juſſi. Intra Triduum autem ſero ſumme adeo diſtentus evaſit, ut jam extima Tumoris membrana diſrupta fuiſſet; metuſque eſſet, ne rupto confeſtim Tumore, Serum ſemel & ſimul cum ipſa vita efflueret. Punctiunculam ergo ſuaſi, ut Lympha ſenſim emitteretur, edito nihilominus Prognoſtico, ſive aperiretur Tumor ſive non, eum fore lethalem.

Infans interea inſomnis & ejulans parum dormivit, ad Pulticulam vero ſatis apta.

Quarto adeo Die Tumorem aperuit Chirurgus, facto largiore paululum quam conſuluiſſem *Orificis*, ita ut omnis intra Horas viginti effluxerit Humor. Hinc Languor ſummus & frequens Deliquium ad Biduum ſaltem; at nutrice ſana & Julap. Cardiaco, Cephalic. refecta viceſſimum ad uſque Diem Vitam perduxit, quo frigidi Sudores & Tremores aborti tremulam hanc Lucem extinxere.

Inciſo Corpore obſervavimus Dorſalem Medullam ad ultimam Lumborum vertebram, nec ultra, pertingiſſe; ſed hanc inter & os ſacrum (ſi mavis primum os ſacrum) exeuns per Tumoris ſive Sacculi membranas diſpertita fuit. Os ſacrum porro fuit ſolidum penitus, nec Propagines nervoſas Medullae ſpinalis (quibus apud Anatomicos Cauda Equina Vocabulum eſt) ad Crura Pedeſque tranſmiſit; quinimo ne quidem perforatum fuit omnino.

In quibuſdam ſaltem a Tulpianis Hiſtoriis ſupra citatis differt haec noſtra: neque enim aliquid matri praegnanti negatum neque vel ſe Ictu aut Foetum Imaginatione læſerat unquam, neque Spina hujus Infantis bifida aut lacera: quinetiam nec os ſacrum ſolidum, nec Pedes contractos & immotos meminit Tulpius. Quandoquidem ergo ſingulare quid habeat haec noſtra Hiſtoria, hanc ego tranſcripſi.

II. *An Account of the Imperial Salt-works of* Sóowár *in* Upper Hungary, *tranſlated from the* High-dutch *of* Erneſt Bruckman *of the Academy of* Brunſwick, *M. D. communicated by Sir* Hans Sloane.

Soowár is an *Hungarian* Word (which ſignifies in *German* Salt-burg) compoſed of *So*, which is to ſay Salt, and *Wa*, which ſignifieth Burgh or Town. It is a large Village, about a Quarter of a Mile from *Eper*, a City of the County of *Saár* entirely peopled with Officers of the Exciſe, and Miners or Wood-cutters, and is ſituated on the Summit of a little Hill, with an agreeable Proſpect.

The 16th of *July* 1724, we came from *Roſenaw* to *Sóowár* with Dr. *Poekin*, Phyſician to the City and County, to view this celebrated Salt-work, which furniſhes the fineſt and moſt pure Salt of the whole Kingdom. We communicated our Intention to an Officer of the Salt-works, and having asked his Leave to go into the Cuts, he gave us two Guards for Guides. We firſt deſcended with them into the Well by a Rope, ſeat-

ſeated on *Leathern Dogs* (as they term it) about forty Fathom deep; after which we again deſcended one hundred Fathom, by holding ourſelves perpendicularly againſt the Wall and Sides of the Wells; and having again continued our Journey under Ground in the Salt-work, we then found ourſelves in the Cuts, and ſaw all the Allies cut in the fineſt Rock-Salt; in the midſt of which there were here and there ſome Veins of Flint of a dark Grey. The Miners work to cut this Rock-Salt, which they draw up by a Rope, and put it into a Reſervoir, where they cleanſe it with Salt-water. They boil it afterwards with the ſame Water, until it becomes of the Conſiſtence of Cryſtal, and then put it into Veſſels, which contain about 268lb. Weight each, and then ſend it into *Sileſia* and other Countries.

In regard to the Vegetable or Foſil Salt, it is extreamly white and tranſparent; it is in ſuch Plenty in the Salt-works of the County of *Marmar* near *Tranſylvania*, where there are large Mountains entire of Salt, that one might furniſh the whole World, in regard to the great Quantity; as alſo, becauſe as ſoon as you cut it, it grows again a-new in a very ſhort Time. They break and cut it, and although it appear at firſt black, nevertheleſs in pounding it becomes extreamly white: And ſo it is with that which they uſe themſelves in *Hungary* (for they ſend all the Salt of *Sóowár* into Foreign Countries.) You find almoſt in every Inn, two Stones like to thoſe uſed to make Muſtard, between which they pound and break that Sort of Rock-Salt; and one finds alſo in their Stables, large Pieces of that Mineral, which the Cattle lick at Pleaſure.

But to return to the Salt of *Sóowár*, one finds ſometimes in the Cuts, Allies of Rock-Salt of the moſt delicate blue and yellow Colours: We obſerved, that of the firſt Colour being expoſed to the Sun for ſome Days, loſt entirely all that beautiful Ultra Marine, and became white as the other Rock-Salt, which did not happen to the Yellow, which preſerved its Colour; but when you pound them both together, the Salt was neither Blue nor Yellow, but produced a Salt extreamly White.

Meliſſantes in his new Geography, *Page* 228, ſpeaking of Salt-works, which the *Spaniards* have in *Catalonia*, ſays, that there is Rock-Salt, the Colour of which is ſo diverſified, that it comes near the Rainbow, in having green, red, yellow, and blue Colours, but that by firſt preparing, and then grinding it, it became white. The ſame Thing happened alſo to the red Rock-Salt of *Saltsburg*, which being pounded became White.

There is in this Mine one very remarkable Thing, that is, a Chapel, which is able eaſily to contain a hundred People, cut in the Rock-Salt, with an Altar, a Pulpit, a Sacriſty, Chairs, and Forms cut in the ſame Rock. They celebrate once every Year, the Week after the *Epiphany*, Divine Service in this Chapel. It is always a Jeſuite of *Eper* who preaches the Sermon. This Service was founded for the Officers of the Exciſe, and the Miners.

There is in theſe Cuts, four Fountains of Salt Water, which they put into Buckets made of Buffalo's Skins ſewed together, and draw it up by an Engine worked by Horſes, and convey it by Pipes into the Boilers, where they put the Rock-Salt to diſſolve,

which

which they afterwards boil till it becomes like Cryſtal. By expreſs Mandates of the Emperor, no one can ſell that Foſil Salt, neither can the *Hungarians* employ it for their own Uſe, much leſs drive any Trade in it, but they boil it all, and export it into foreign Countries.

They find here alſo a Sort of Cryſtalized Salt, like to the Cruſt ſticking to the Pipes of Wood: The Miners call it Salt of Cryſtal; it is very white and tranſparent, but this appeared to us, nothing elſe but Salt falling Drop by Drop in its Paſſage in the Pipes, and ſo cryſtallizing, which they eaſily alſo ſeparate.

But that which is moſt curious and remarkable in theſe ſubterraneous Foſſes, are the Flowers of Salt which grow as the Beard of a Goat, with this Difference only, that theſe here are much whiter, and much finer. One cannot enough admire theſe Vegetables, yet one cannot find them in all the Cuts, nor at all Times, but they appear and grow according to the Temperature of the Seaſons, which in thoſe Parts is very wholeſome, and without any thing noxious. Theſe Sort of Plumes of Salt are very brittle, they melt alſo in moiſt Places, and diſſolve into an evaporated Oil, but are nevertheleſs the moſt pure Salt, the fineſt, the moſt acid, the moſt white, and moſt beautiful; ſo that it is not without Reaſon they have given it the Name of Flower of Salt.

The Salt of *Sóowár* is eſteemed the beſt of all *Hungary*, the greateſt Part of which they export into *Sileſia*, *Moravia*, and *Bohemia*, and the *Hungarians* dare not uſe any of it themſelves, under Pain of Baniſhment. They make every Year about 50,000 Tun, every Tun containing 268lb. but by an Ordonnance

donnance of his Imperial Majeſty, they will henceforward boil about 100,000 Tun, which they will export as the other. *Martin Zeiler*, in his Deſcription of the Kingdom of *Hungary*, *Pag.* 119, makes but ſlight Mention of theſe rich Salt-works.

In fine, we ſaw at *Neuſol*, at Mr. *De Neffzerns*, Receiver of the Emperor's Rents, a Statue of Rock-Salt as large as Life, which ſerves as the Barometer of *Neuſol*; for when it begins to ſweat, or grow moiſt, it preſages Rain, or wet Weather; but when it is dry, you may certainly promiſe yourſelf ſettled fair.

After having employed three Hours to view theſe Salt-works, we aſcended again by the upper Opening, by a common Rope, and returned to *Eper*, where we were civilly entertained by Mr. *Topprerer*, one of the moſt knowing Men in all *Hungary*, Rector of the *Lutheran* Academy, who underſtands and ſpeaks ten Languages in Perfection.

III. *The natural Hiſtory of Cochineal*; *being an Account of a Book entituled*, Hiſtoire naturelle de la Cochinelle juſtifiée par des Documens authentiques Amſterdam, 1729. *By* W. Rutty, *M. D. R. S. Secr.*

A Diſpute ariſing betwixt the Author (*Melchior de la Ruuſcher*) and a Friend, concerning the Subſtance of Cochineal, the one maintaining it to be a ſmall Animal, the other the Fruit, or Grain of a Plant, the Author took the Pains to procure from

Antiquera

Antiquera in *New Spain*, the Place where there is the greateſt Traffick for it, the Atteſtations upon Oath of eight Perſons who have been immediately employed in propagating and managing it for many Years; from whence the whole Natural Hiſtory of this Drug is collected. Theſe ſhew, *Firſt*, in Regard to Cochineal it ſelf,

That they are ſmall living Animals with a Beak, Eyes, Feet and Claws; that they creep, climb, ſeek their Food, and bring forth Young, not changing their Species as Silk-Worms, but producing their Like; which are not larger than Nits, or ſmall Mites, or the Point of a Needle; but when come to Maturity, reſemble in Size and Figure a Dog's Ticke. Thus far is certain, but their Manner of Generating is doubtful, though it is commonly believed by thoſe who cultivate them, that they are impregnated by a ſmall Butterfly, which is bred upon the *Nopal* (the Plant they live upon) which paſſes and repaſſes over them.

Secondly, As to the Manner of raiſing, nouriſhing, and managing them, it appears, that at the proper Time, *viz.* after Winter (when theſe little Animals can bear the open Air) when the Cochineals which they have kept in their Houſes are grown ſo large and big as ſoon to produce young ones, they put 12 or 14 together into a *Paſtle*, or little Neſt made of fine ſoft Hay or Straw, or Moſs of Trees, or the Down which immediately invellopes the Cocoa Nut. Theſe *Paſtles* are then placed upon the Plants of the *Nopal*, or Prickly *Indian Fig* (which they take Care to cultivate well for this Purpoſe) and in 2, 3, or 4 Days, theſe Animals bring forth a great Number of young ones; ſoon after which the Mothers die. In the mean

while the young ones, coming out of the Neſts, climb up the *Nopal*, fix themſelves to it, and ſuck its Juice, which is their only Nouriſhment, but don't eat the Plant; and for this Reaſon, they always ſeek thoſe Parts of it that are greeneſt, and fulleſt of Juice, taking Care at the ſame Time to place themſelves on the Parts moſt ſheltered from the Wind and Weather. During this Time, whilſt they are growing up, and become pregnant, great Care is taken that no Vermin incommode or kill them, as alſo to keep them clean, and diſengage them from certain Threads, like Cobwebs, that grow upon the *Nopal*: As likewiſe to defend them from too much Heat, or Cold; from the Rain and Winds; becauſe the fine Cochineals are very tender: Nevertheleſs the wild Cochineals ſtand all theſe Inconveniencies; but then they are ſo gritty, of ſo ill a Smell, and of ſuch little Value, that they ought not to be mix'd with the fine.

Thirdly, In Regard to the gathering of the Cochineal: The firſt is of the Mothers, which having brought forth their Young, have died in the Neſts. Three or four Months after this, as the Seaſon permits, when the firſt young ones are become ſufficiently large and big, and are in a State to bring forth Young in their Turn, and alſo have produced ſome few, the *Indians* carefully gather them off the *Nopals* with a little Stick, to which they have fixed a little Hair in the Nature of a Pencil. Theſe Animals being collected in this Manner, and afterwards killed by hot Water or Fire, this is called the ſecond Gathering, or rather the firſt of the young ones that have been nouriſhed and raiſed in the open Air. Three or four Months after this, they gather the ſecond

Brood

Brood of thoſe that have been born upon the *Nopal*, which being become big, have brought forth already ſome young ones. This they do much in the ſame Manner as before, only now they take off the Plant a great many young ones with their Mothers, which makes this Sort of Cochineal be called *Granilla*, from the Number of ſmall ones found in it. In the mean Time they keep a Number of theſe young ones alive, upon the *Nopals*, which they pluck up or cut, and lock up in their Houſes, to nouriſh theſe Animalcules during the rainy Seaſon. *Laſtly*, Theſe being grown large, they put them into the Paſtles and proceed in the Manner above expreſſed in the ſecond Article. So that for the moſt Part they make three Gatherings in a Year.

Fourthly, As to the Manner of killing the Cochineal: This is commonly done two Ways, either in hot Water or in *Tamaſcales*, which are little Ovens made for that Purpoſe, though there are ſome People who kill them by roaſting them upon *Comales*, which are flat Stoves with Fire under them, made uſe of by the *Indian* Women to bake their *Maiz* Bread. Theſe three different Methods give the Cochineal three different Colours. The firſt renders them of a brown Red; the hot Water making them loſe the white Colour with which they are covered when alive. The ſecond makes them of an Aſh Colour and Marbled, or Jaſpered; both upon Account of the natural White with which they are covered, and the red and tranſparent Colour of the Cochineal it ſelf. The third Sort becomes black, as if it had been burnt. Of the old ones which died after dropping their young, four Pounds produce but one, when

dried; or rather, one Pound is reduced to four Ounces: But three Pounds only of the living, which have been carefully taken off the *Nopals*, being killed and dried, produce as much.

This is the Subſtance of what I can collect from the Atteſtations, *&c.* which are printed and annexed at length, which the Collector ſays he has done, both as they contain many Circumſtances unknown hitherto, both in his own Country (*Holland*) and elſewhere; and as the Curious may be now aſſured of a Thing which has been very uncertain for ſo many Years, and indeed known but very ſuperficially, even by thoſe who have embraced the Opinion, that the Cochineals were really little Animals. And as there may be always a ſtanding Evidence to evince the Truth of theſe Facts, he has thought fit to depoſite the original Atteſtations, confirmed by the Certificates of three Magiſtrates, and three publick Notaries, among the other Regiſters of the *Royal Society*, by the Hands of Mr. *Eaſt* Surgeon, a Member of our Body. That this therefore may be publickly known, I have, in Purſuance to Order, inſerted an Abſtract here.

IV. *An*

Tab. 1.ma

Philo: Trans: N.o 4

Fig: 1.



Fig: 2.



Tab. 2.da

Fig: 1.



Fig: 2.



Fig: 3.



Fig: 4.

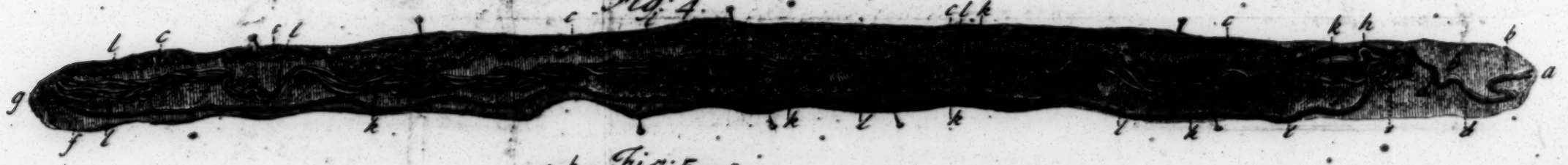


Fig: 5.



Fig: 6.



Fig: 7.

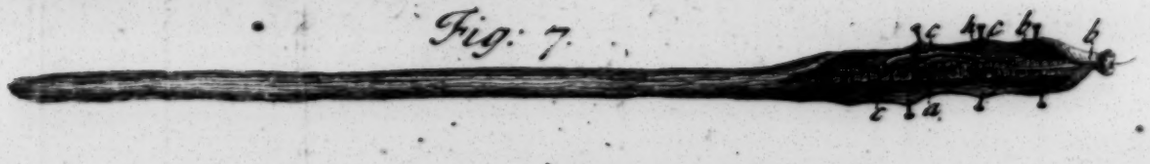


Fig: 8.

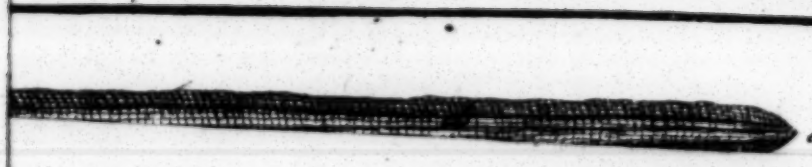


Scarpetta Veneta fec.

Fig. 1.



Fig. 2.



4.13.

IV. *An Anatomical Deſcription of Worms, found in the Kidneys of Wolves, in a Letter from Mr.* James Theodorus Klein, *Secretary of the City of* Dantzick, *F. R. S. to Sir* Hans Sloane, *Bart.* &c.

I Now lay before you, Sir, ſome Worms found in the Kidneys of Wolves, to which we commonly give the Name of Vipers. Of theſe one may read in divers Places of the *Curioſities of Art and Nature*, collected at *Breſlaw*. They were ſent to me from *Sewaldia*, in *Eaſtern Pruſia*, the Eſtate of a Gentlewoman named Madam *Roſe*.

The firſt PLATE.

Fig. 1. exhibits a female Worm found in the Kidney of a ſhe Wolf.

Fig. 2. The Kidney of a Wolf, reſembling a Bag, on Account of the almoſt entire Conſumption of its *Parenchyma*. It contained eight Worms, ſome of a yellowiſh, others of a Blood Colour; *two* of which were *Females*, *ſix Males*.

Being deſirous to ſee the Diſſection of theſe from the Bag, I ſent for my good Friend, the moſt learned and ingenious *David Kade*, M. D.

The Diſſection of each Sex is ſhewn in

The ſecond PLATE.

The *Females* were more than twice longer and thicker than the Males. They were furniſhed with three very viſible Holes; the firſt of which perform-

ed

ed the Function of the Mouth; the ſecond of the *Anus*; the third of the *Vulva*. This laſt Hole is ſeen under the Belly, about 1 ½ Inch from the Mouth. (*Fig.* 1. *a*, *b*, *c*.

The membranous Skin was marked with annular Fibres, and 7 or 8 Cheſnut-coloured Lines (*Fig.* 1. *d*.) running the whole Length of the Worm. The Skin being cut, a limpid Humour iſſued forth, and then appeared the tranſverſal Fibres interlaid on every Side with the *Viſcera*, and are all round about inſerted into the Skin in the Interſtices of the *Veſicles* (*of which hereafter*) and at the ſame Time the *Viſcera* appeared, which the *ſole* Parts deſtin'd for *Nutrition* and *Generation* ſeem to make up.

As to the firſt, or alimentary Paſſage, it is compoſed of two Canals, one whereof (*Fig.* 2. *b*, *b*.) which begins at the Mouth, and is about 2 Inches long, ſmooth, fleſhy, whitiſh, and endow'd with thick Coats, ſerves for receiving Nouriſhment. As this Duct proceeds with equal Thickneſs, it is once reflected and retorted before it enters the other (*Fig.* 2. *c*, *c*, *c*, *d*.) which is of a dark brown Colour, much broader and tenderer than the firſt, flatted, membranous, covered with very fine Coats, wrinkled like a *Swathing Cloth*, then runs into tranſverſal and winding Sinews, and extends in a ſtrait Line to the *Anus*. The inner Coat of this Canal ſeemed ſomewhat rough, and as it were ſtrew'd with Duſt. The contained Liquor was perfectly fluid, and of a faint ſooty Colour.

But the Organs of Generation we found thus. Near the *Anus* was fix'd to the Skin, the End of a whitiſh tender Veſſel, which thence proceeded ſtrait to the Beginning of the alimentary Canal, where re-

flecting

flecting towards its Origin, and again reſuming its firſt Way, after being contorted and implicated in many and various Windings and Curves, widens and ſtraitens here and there, until at length becoming more and more capacious, it forms a little Bag, for which a whitiſh, fine, ſmooth Canal, about an Inch long, covered with pretty thick Coats, piercing thro' the Skin 1½ Inch from the Mouth, prepares an Outlet, marked under the Belly with a Caruncle (*Fig.* 1. *c.* *Fig.* 3 *and* 4. *b.*) This little Canal may be, not improperly, called the *Oviduct* or *Vagina.*

The Colour of theſe Parts is not every where the ſame; for of whitiſh at the Beginning, in the Progreſs it inſenſibly becomes darker: And at length, where the Veſſel acquires a greater Volume, and eſpecially where it ſtretches forth into the Bag, it is of a Cheſnut Colour. And as far as this Cheſnut Colour continues, the Veſſel is thick ſtuffed with *Myriads* of Eggs, and therefore is to be called the *Ovary.*

The Eggs, whoſe Number is certainly incredible, ſeen with the naked Eye, reſemble a *Magma* of a brown Colour; but viewed through thoſe Microſcopes, which in the *Engliſh Apparatus* bear the ſecond and third Number, they are of the Figure marked *a* and *b* in *Fig.* 5.

The Surface of the inner Skin which incloſed the abdominal Contents, was all beſet with ſmall whitiſh Bladders, of different Figures and Bulks, pouring out a Lymph upon tearing them. Theſe were in the Females.

Though the Integument of the *Male* be marked with annular Fibres, and as many Cheſnut-coloured Lines as that of the *Female*, throughout its whole

Length, yet his external Shape differs from that of the *Female*, *Firſt*, Becauſe, as I have already ſaid, he is much leſs. *Secondly*, Becauſe, the third Hole, *viz.* that under the Belly, is wanting in the *Male*. *Thirdly*, Becauſe the *Anus* of the *Male* is ſurrounded with a thick cartilaginous Membrane, of near an orbicular Figure, about a Line broad, externally convex, internally concave; on the Middle of which appears a Tubercle, divided by a fine Slit, which lets out the Excrements and a very ſmall capillary Proceſs (*Fig.* 6. *k.*)

The Cavity of the Belly contained a limpid Humour, the tranſverſal Fibres, the alimentary Canals, and ſpermatic Veſſels.

The alimentary Paſſages had the ſame Situation and Structure as in the Female; the anterior Canal was of a whitiſh Colour, the poſterior, or wrinkled one, of a pale brown.

The ſpermatick Veſſels were very white and ſlender, yielding, when wounded, a milky Humour. They are divided into two ſmall Branches, hanging out of a vermicular Proceſs (ſcarce an Inch long) which lies in the Belly, in that Place where the alimentary Canals are joined together, and leans on the Side of the wrinkled Canal, by the Help of the tranſverſal Fibres. Theſe Branches, in their Progreſs hence, creeping above and below the Canal of the Aliments, are very often reflected, intorted and folded; one at length freed from its Windings, ſtretches away ſtrait towards the *Anus*, into which it is inſerted in the Shape of a pretty ſtiff Veſſel; but the other, at the Side of the wrinkled Canal, being preſſed, collected, and equally inflected, almoſt through its whole Extent,

tent, by the tranſverſal Fibres, ends in the oppoſite Side, by an Extremity pendulous in the Belly, not far from the *Anus*.

The inner Coat of the Skin, juſt as in the Females, is all covered with ſmall whitiſh Bladders, turgid with Lymph, but leſs, in Proportion to the leſſer Bulk of the Worm.

Moreover, we found under the wrinkled Canal a certain whitiſh Duct expreſſed in *Fig.* 7, and marked with the Letters *b*, *b*, *b*, firmly connected to the aforeſaid Inteſtin by its fineſt Part; but whoſe Outlet or Origin, the Tenderneſs of the Inteſtin, and Fineneſs of the Duct hindred us from tracing with Exactitude.

So much I humbly beg, Sir, you'll not take amiſs. Furthermore, 'tis great Pity that the excellent Work of the moſt illuſtrious Count *Marſilli*, of the Hiſtory of the Sea, was ſo inaccurately printed. We have thought it well worth our while, not only to make the Corrections and Additions it wanted, but alſo to draw up an Index of its Contents, which we intend for our own more commodious Uſe of that Book. To theſe I add an Example thereof: And if it proves acceptable, you may expect, at a proper Time, the Fruits of another Labour, perhaps not leſs uſeful.

It remains to wiſh you all Proſperity, and aſſure you that I am, *&c.*

From my Study in Dantzick,
Decemb. 3*d*, 1726.

The EXPLICATION *of the Figures of the ſecond Plate, drawn according to their natural Bigneſs.*

Fig. 1. The Shape of a Female Worm; *a*, the Mouth of the Worm; *b*, the *Anus*; *c*, the *Vulva*; *d*, the Cheſnut-coloured Lines running along the Worm's Length.

Fig. 2. *a*, the Worm's Mouth; *b*, the alimentary Canal, which is white, carnous, &c. *c*, the alimentary Canal, which is brown and flatted, and whoſe Extremity is in the *Anus*; *d*, the Place where the Canals join; *e*, *e*, *e*, the tranſverſal Fibres; *f*, the *Anus*.

Fig. 3 and 4. *a*, the Worm's Mouth; *b*, *b*, the firſt alimentary Canal; *c*, *c*, the latter alimentary Canal; *d*, the Place where theſe two Canals cohere; *e*, *e*, *e*, the tranſverſal Fibres; *f*, *f*, *f*, the white Veſicles turgid with Lymph, with which all the inner Skin is thick beſet; *g*, the *Anus*; *h*, the *Vagina*; *s*, the *Oviduct*; *i*, the Outlet of the *Vagina*, or the *Vulva*; *k*, *k*, the Ovary fill'd with innumerable Eggs; *l*, *l*, the preparing Veſſels.

Fig. 5. The Eggs viewed though a Microſcope; *a*, through the Microſcope, N°. 3; *b*, through the Microſcope, N°. 2.

Fig. 6. A Male Worm; *a*, the Mouth of the Worm; *b*, *b*, the whitiſh alimentary Canal; *c*, *c*, the wrinkled Canal of the Aliments; *d*, the vermicular Proceſs of the

the ſpermatick Veſſels; *e, e*, a Branch of the ſpermatick Veſſels along the Side of the Inteſtin, compreſſed by the tranſverſal Fibres, and inflected through its whole Extent in an uniform Manner; *f, f, f*, the Windings and Turnings of the ſpermatick Veſſels; *g, g*, the tranſverſal Fibres; *h*, the cartilaginous Membrane ſurrounding the *Anus*; *i*, the ſmall Slit in its Middle; *k*, the very fine capillary Proceſs; *m, m*, the ſmall Bladders covering the Skin.

Fig. 7. A Male Worm inverted, and diſected about the *Anus*, in Order to ſee with Eaſe the Duct lying under the alimentary Canal; *a*, the wrinkled alimentary Canal; *b*, the whitiſh Duct under the wrinkled Canal; *c*, the ſpermatick Veſſels.

Fig. 8. *a*, the vermicular Proceſs of the ſpermatick Veſſels; *b, b*, the Branches of the ſpermatick Veſſels, freed from their Windings; *c, c*, the ſame Branches diſſected.

V. *Some material Obſervations upon diſſecting an Oſtrich, made lately by Mr.* Ranby, *Surgeon to his Majeſty's Houſhold, and F. R. S.*

ABout five Years ago, I laid before the Society ſome Obſervations made in an Oſtrich diſſected, by Order of Sir *Hans Sloane*, Bart. to which Account I beg Leave to add two or three more Obſervations which eſcaped my Notice in my former Diſſection. And *Firſt*, the Eye, the Figure of which, when

taken out of the Orbit, I think particular, being almoſt triangular, with ſome litle Variation in the Bony Scales, from that in *Phil. Tranſ.* N°. 386. The Contents of the Stomach were of ſuch a Kind, that they were hardly capable (without very great Alteration) of paſſing the lower Orifice, which is very ſmall.

The Diameter of the *Duodenum* much ſmaller than any of the Inteſtines, and free from *Valves*, as are the *Jejunum* and *Ileum*, except the latter, which has a few *Valves*, as it approaches near the *Colon*. The *Colon* was uneven, with very regular Cells: Theſe Cells were formed by *Valves*, which were on the Inſide, and tranſverſely ſituated, each making more than half a Circle.

The Parts in other Reſpects anſwer the Deſcription given by the ſeveral curious Gentlemen that have diſſected this Animal.

VI. *A new Kind of Hydrometer made by Mr.* Clarke, *and communicated to the Society by* J. T. Deſaguliers, *L. L. D. F. R. S.*

THE Hydrometer, by ſome called Areometer, is an Inſtrument commonly made of Glaſs, as repreſented by Figure 1, conſiſting of a Stem A B, graduated by ſmall Beads of Glaſs of different Colours, ſtuck on the Outſide, a larger Ball, B, quite empty as well as the Stem, and a ſmall Ball, C, filled with Quickſilver before the End A, was hermetically ſealed, in ſuch Manner as to make the Hydrometer ſink in Rain Water as deep as *m*, the Middle of the Stem. Such an Inſtrument does indeed ſhew the different ſpecifick Gravity of all Waters or Wines, by ſinking deeper in the lighter, and emerging more out of the heavier Liquors; but as it is difficult to have the Stem exactly of the ſame Bigneſs all the Way, and if it could be had, the ſame Inſtrument would not ſerve for Water and Spirits, ſinking quite over Head in Spirits when made for Water, and emerging in Water with Part of the great Ball out, when made for Spirits. The Hydrometer has only been uſed to find whether any one Liquor is ſpecifically heavier than another; but not to tell how much, which cannot be done without a great deal of Trouble, even with a nice Inſtrument. The Hydroſtatical Balance has ſupplied the

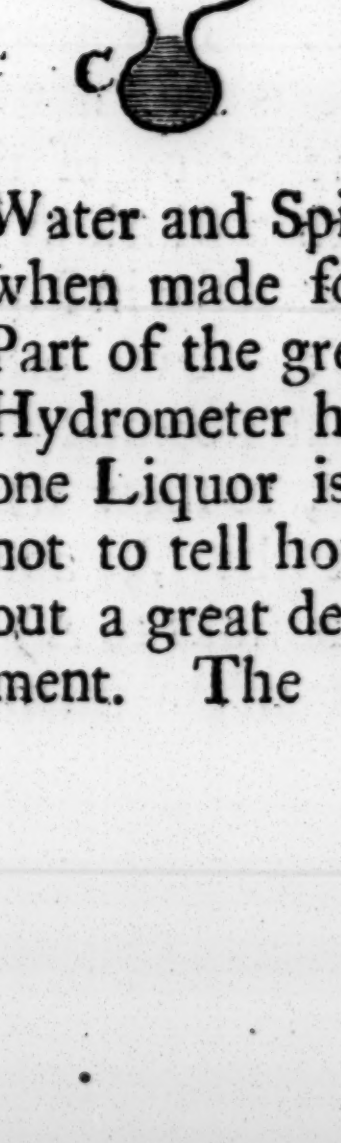
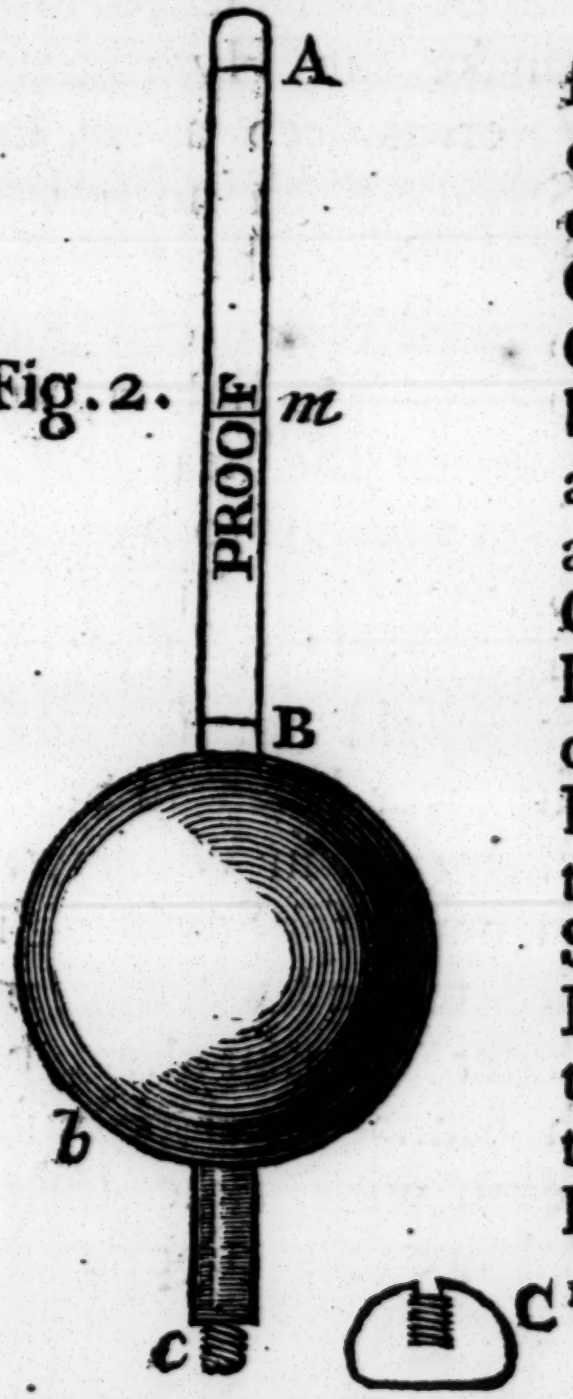


Fig. 1.

Place

Place of the Hydrometer, and ſhews the different ſpecifick Gravity of Fluids to a very great Exactneſs. But as that Balance cannot well be carried in the Pocket, and much leſs managed and underſtood by Perſons not uſed to Experiments, Mr. *Clarke* was reſolved to perfect the Hydrometer for the Uſe of thoſe that deal in Brandies and Spirits, that by the Uſe of the Inſtrument they may, by Inſpection, and without Trouble, know whether a ſpirituous Liquor be Proof, above Proof, or under Proof, and exactly how much above or under: And this muſt be of great Uſe to the Officers of the Cuſtoms, who examine imported or exported Liquors.

Fig. 2.



After having made ſeveral fruitleſs Trials with Ivory, becauſe it imbibes ſpirituous Liquors, and thereby alters its Gravity, he at laſt made a Copper Hydrometer, repreſented by *Fig.* 2, having a Braſs Wire of about $\frac{1}{4}$ Inch thick going through, and ſoldered into the hollow Copper Ball, B *b*. The upper Ball of this Wire is filed flat on one Side, for the Stem of the Hydrometer, with a Mark at *m*, to which it ſinks exactly in Proof Spirits. There are two other Marks, A and B, at Top and Bottom of the Stem, to ſhew whether the Liquor be $\frac{1}{10}$ above Proof (as when it ſinks to A) or $\frac{1}{10}$ under Proof (as when it emerges

ges to B) when a Brass Weight, such as C, has been screwed on, to the Bottom at *c*. There are a great many such Weights of different Sizes, and marked to be screwed on, instead of C, for Liquors that differ more than $\frac{1}{10}$ from Proof, so as to serve for the specifick Gravities in all such Proportions as relate to the Mixture of spirituous Liquors, in all the Variety made Use of in Trade. There are also other Balls for shewing the specifick Gravities quite to common Water, which makes the Instrument perfect in its Kind.

VII. *An Account of an* Aurora Borealis *attended with unusual Appearances, in a Letter from the Learned Mr.* G. Cramer, *Prof. Math.* Genev. *to* James Jurin, *M. D. and F. R. S.*

I Have been so overcharged with Business since I came here, that I had hardly Time enough to think of writing.

Being now a little more at Leisure, I would not miss the Occasion of an *Aurora Borealis*, which appeared here the 15th of *Feb.* N. S. accompanied with some Circumstances rare enough to be worth your Consideration.

The *Aurora* it self had nothing extraordinary; it was a quiet one, that is, without any sensible Motion, except, perhaps, an alternative Increase and Diminution of apparent Altitude. Whether it was for this Reason, or because the Light had its Edge imperceptibly confounded with the Colour of Heaven, several People judged of that Altitude severally. There are some that

that pretend to have ſeen it to the very Zenith: I was not ſo happy, and could not ſee it higher than the Girdle (β) of *Cephus*, which was about 30 Deg. high. The greateſt Part did fix it to the Polar Star, which is about 46 Deg. Its Baſe reached from the Head of *Andromeda* and further, to the Shoulder (γ) of *Bootes*, and further, and ſo it did inſiſt upon an Arch of 140 or 150 Deg. of the Horizon. This Meaſure was taken half an Hour after Eight. Its Middle declined from North to Weſt about 15 Deg. The Light was ſtill, and clear enough to read a Character no bigger than that of this Letter. The Baſe has ſeemed obſcure to ſome People.

But what was chiefly to be conſidered, was a great Meridional Zone pretty like a Rainbow in its Figure, but broader. It was terminated by two parallel Arches. The ſuperior inſiſted with one Side upon the true Point of Eaſt, and with the other upon the Point of South-weſt, or Weſt-ſouth-weſt: Whence you ſee its Middle declined about 15 Deg. from South to Eaſt, and was diametrically oppoſed to the Middle of the *Aurora Borealis*. Its Altitude did vary a little, but never reached higher than the Head of *Orion*, which was 54 Deg. high, and never was ſeen lower than a little under *Procyon*, which is an Altitude of 45 or 46 Deg. The inferior Arch was exactly parallel to the ſuperior, and the Breadth of the Zone varied from 14 or 15 Deg. to 18 or 20 Deg.

The Colour of this Zone was Red, Scarlet, inclined to Purple, pretty lively and changeable by Intervals. It was leſs vivid near the Horizon, and alſo to the Meridian, where it ſeemed now and then interrupted. Some Standers by did imagine two great Arches riſing,

one

one from the Eaſt, the other from the South-eaſt, and meeting together near the Meridian, but immediately afterwards parting one with another, and drawing back, which they repeated very often.

Under this Zone then was to be ſeen, but not conſtantly, one or two Arches lucid and interrupted, which comprehended with the Horizon a dark Segment very like a Miſt.

The Phænomenon did laſt till Four o' Clock in the Morning. The Weather was calm, ſerene, and cold, the Barometer very high; no Cloud in the Heaven.

It was remarkable, and I think extraordinary, that this *Aurora* conſiderably darkened the Light of thoſe Stars which were ſeen through it; and that was much more true of the red meridional Zone, which dyed with its reddiſh Colour the Stars that appeared behind. When that Zone was the higheſt, it covered *Jupiter*; and ſome Gentlemen, which at that Time had not yet remarked the *Aurora*, looking at *Jupiter* through a Teleſcope, affirm they could hardly ſee it, but that it it ſeemed as intercepted by ſome dark Cloud; and indeed it looked at that Time as if it had been ſeen through a red Glaſs.

This Obſervation confirms what is moreover very probable, that this Zone was produced by the Light of the oppoſite *Aurora*, either by Reflexion or Refraction. But the Manner of its Production ſeems difficult to be accounted for. There may be ſuppoſed Icy Particles ſwimming in the Air, and of ſuch Figure as to exhibit a great Zone, by the Reflexion and Refraction of the Light of the *Aurora*, almoſt in the ſame Manner as the Drops of Rain produce the Appearance of the Rainbow. But this being meer Conjecture, I ſhall paſs it over.

The *Aurora* and *Zone* ſeemed a great deal nearer one another in the Horizon than in the Top. If we could ſuppoſe this Difference to be entirely Optick, and theſe two Circles really Parallels, that would be enough to compute the Diſtance of the Phænomenon from the Earth. But the Suppoſition, though it ſeemed, at firſt, pretty allowable, is by no means to be admitted; for it would follow, that the Phænomenon was at leaſt diſtant from us one twenty-fourth Part of the Diameter of the Earth, which is too great an Altitude to be believed.

I have ſeen lately another Phænomenon of a quite different Kind. A Friend of mine having cauſed ſome Pipes of Aſh-tree Wood (that brought Water to his Fountain during at leaſt twelve Years) to be taken out of the Earth, they were left in a Yard not paved, where they rotted almoſt entirely: But in their room there did ſhoot forth from the Earth, a little Foreſt of Aſh-trees. They are now in a flouriſhing Way, and about 3 or 4 Foot high. It is remarkable, that more than fifty young Trees are ſprung up exactly where the Pipes had been laid, and no where elſe in the Yard. There is no Aſh-tree there about, nor perhaps at a very great Diſtance, the Yard being in the Town.

I am, with great Eſteem and Reſpect,

Geneva, Febr. *the* 20*th*, 1730, N. S.

Your moſt humble,

and moſt obliged Servant,

G. CRAMER.

VIII. *An*

VIII. *An Account of a* Spiritus Vini Æthereus, *together with ſeveral Experiments tried therewith.* *By* Dr. Frobenius, *F. R. S.*

I. THE Æther of Plants appears to be almoſt deſtitute of all groſs Air, from placing it under the Receiver of the Air-pump; for exhauſt the Air ever ſo accurately, this Ætherial Liquor remains unmoved, nor does it emit any Air-bubbles which immediately ariſe in other Liquors, and according as their Quantity of intrinſick Air is greater, ſo much the ſooner are ſuch Liquors put into Agitation, and emit alſo more Froth, and more vehement Ebullitions in Proportion to Viſcidity.

Hence it follows, that this Æther may be preſerved beſt (becauſe without any Diminution) under the Receiver in *Vacuo*, whereas on the contrary, expoſed to the open Air, its Parts ſoon evaporate, and its whole Bulk, but not compreſſed by the Air, vaniſhes. (*This Experiment fail'd remarkably.*)

II. A little of it poured on the Surface of the Hand, affects it with a Senſe of Cold equal to that from the Contact of Snow, and blow upon it but once or twice with your Mouth, immediately your Hand becomes dry. Beware however of approaching a lighted Candle with your Hand thus wet, leſt it take Fire and burn you. (*Succeeded.*)

III. It cauſes ſuch a Stridor and Hiſſing, poured upon hot Water, as is frequently occaſioned by a Piece of hot Iron thrown into it. Take a Lump of Sugar, imbibe ſome of this Æthereal Liquor, and put it into

a Veſſel full of hot Water, the Sugar will indeed ſink to the Bottom, but the Æthereal Liquor ruſhing violently forth, excites a great Ebullition in the Water. Moreover, if one Spoonful of this Æther be poured into a Copper-Pot-full of boiling Water, without any Sugar in it, and approach immediately with a Candle or a lighted Paper, inſtantly there iſſues forth from the Water very great Lightning. The Handle of a Spoon, as well as the Tongs for holding and applying the lighted Paper, muſt be of a proper Length, that the Effuſion of the Ætherial Liquor upon the hot or boiling Water, and the Application of the lighted Candle or Paper may be performed at the ſame Time; otherwiſe the Æther is immediately diſſipated, without any ſuch Effect. " There is therefore Need of " an Aſſiſtant, or of both Hands, and alſo of a Room " where Entrance may readily be given to freſh " Air, proportionable to the Magnitude of the Flaſh " of Lightning which ſo rarifies the Air as to endan- " ger the Stoppage of Reſpiration. (*Succeeded.*)

IV. Hence it appears, that this Æther is both Fire and a very fluid Water, but ſo volatile as it ſoon evaporates, and that it is the pureſt Fire; inſomuch, as if kindled in a thouſand Times the Quantity of cold Water, it burns inextinguiſhably. Wherefore, if you take an earthen Veſſel of any Magnitude, whoſe Mouth or Orifice may be one or two Yards wide, but the inferior Latitude of the Veſſel may contain 600, or 6000 Gallons of Water, the Experiment will be the ſame, pour on the Top but one Ounce, or a ſmall Vial full of this Æther, and apply to it a lighted Wax-candle, it takes Fire immediately, burns placidly, and is ſo far from being extinguiſhed by the

moſt profuſe Supereffuſion of common Water, that it much encreaſes the Vehemence of the Flame, and laſts till the ſubtil Parts of the Æther are conſumed and ventilated by the Flame. This Experiment ſhould be made in a large and lofty Room, not in Danger of taking Fire. (*Not ſhewed.*)

V. The Senſe of Touch does not manifeſt the leaſt Oilineſs or Fatneſs in this Æthereal Liquor, notwithſtanding that it is the true, natural, and only Diſſolvent, or Menſtruum of all Fat, Oil, Roſin and Gum whatſoever: By means whereof all Sorts of Fat, and every Kind of Fire or Flame is extricated by a ſpeedy, ſafe, and pleaſant Operation. On theſe Accounts it is that this Æthereal Liquor will not unite with any Kinds of Salts whatſoever, but all Sorts of Oils, Pitch, Turpentine, Opobalſams, Camphire, Wax, Ambergreaſe, Sperma Cete, Maſtick, Musk, Copal, and the like, it diſſolves moſt readily, and with the greateſt Eaſe extracts their beſt Eſſences.

VI. And indeed a wonderful Harmony is obſervable betwixt Gold and this Æther, even greater than between Gold and ▽Regia; inſomuch as from hence Gold appears to approach nearer to the Nature of Oils than of Earths, as ſhall be proved when we treat in their proper Place of the three harmonious Menſtrua which we have diſcovered, *viz.* The corroſive one for the Devoration or Diſſolution of Earths, Minerals, and Metals; the aqueous one for the Diſſolution of all Kinds of Salts; and laſtly, the Æthereal Liquor, or *Oleus Menſtruum.* If a Piece of Gold be diſſolved in the beſt *Aq. Regia*, and upon the Solution Cold, be poured half an Ounce, or what Quantity you pleaſe of the Æthereal Liquor, ſhake the Glaſs

care-

carefully, and all the Gold will paſs into the Æthereal Liquor, and the ▽Regia, robbed of all its Gold, will preſently depoſite the Copper at the Bottom of the Veſſel as a white Powder, which turning of a green Colour, contains the Portion of Copper wherewith the Gold was adulterated. The Æther will ſwim like Oil on the Surface of the corroſive Waters. The Experiment deſerves the utmoſt Attention; for here the heavieſt of all Bodies, Gold, is attracted by this very light Æther, or (whereas the Air, which with a common Force preſſes alike all Bodies, is here excluded, and the Æther it ſelf encompaſſes and touches the Surface of the Water) the Gold, by the Force of its Gravity, as by an Impulſe, would deſcend from thence; or laſtly, this Phœnomenon is owing to a certain Harmony and Similitude of both of them. (*Succeeded.*)

VII. Æther then is certainly the moſt noble, efficacious and uſeful Inſtrument in all Chymiſtry and Pharmacy, *Ubi enim ignis potentialis, ibi actuali non opus eſt*, inaſmuch as Eſſences and eſſential Oils are extracted by it immediately, without ſo much as the Mediation of Fire, from Woods, Barks, Roots, Herbs, Flowers, Berries, Seeds, *&c.* from Animals, and their Parts too. Thus from Caſtor, by a certain Manufaction, may be prepared an Oil ſweeter than that of Cinnamon, and alſo the true Oil of Saffron, of wonderful Efficacy; and all by this particular Enchyraſis, without the Help of Fire or Diſtillation. For an Example of our Method, take Mint, Sage, or Orange-peels, Cinnamon, *&c.* or all theſe together, cut and bottle them, pour upon them a Spoonful or two of the Æthereal Liquor, and after it has ſtood

an

an Hour in a cold Place, fill up the Bottle with cold Water, and you ſhall ſee the eſſential Oil, ſwimming upon the Water pour'd upon them, eaſily ſeparable by the Funnel, or *Inſtrumentum Tritorium*. Of this eſſential Oil, one Drop only upon a Lump of Sugar, manifeſts to the Taſte, *&c.* the medical Virtues of the Plant, exquiſitely drawn out, comprehended in this Eſſence, deſervedly named *C O S*, as containing the Colour, Odour, and Sapor or Taſte of the Plant or Plants. In like manner the eſſential Oils of Exoticks are eaſily prepared. (*Succeeded.*) But it is not a true eſſential Oil, but an exceſſive ſtrong Tincture, which you may call the Eſſence.

VIII. Of the like Uſe it is in the Animal Kingdom, where it produces an eſſential Oil of *Phoſphorus*, as likewiſe in the mineral Kingdom, though not ſo immediately, becauſe the Reſolution of Earths muſt precede. Moreover, it is eaſily proved that the ſame Liquor extracts the pureſt Gold, or every Part of the golden Syſtem from any, or all the baſer Minerals, and that this Gold thus extricated, is by this one Operation better and ſooner purified than by Fuſion of Minerals with Antimony.

IX. This our Water is neither corroſive nor join'd with apparent Corroſives: Wherefore fill as many Bottles with Æthereal Water as there are Sorts of Salts, and into the firſt, Drop by Drop diſtill Oil of Vitriol; put into the Second Spirit of Sea-ſalt, into the Third Spirit of Nitre, or of Alum, or of Sal Armoniack prepared with Water, or the Lixivium of Tartar, or rectified Wine-vinegar, all the Salts immediately ſink to the Bottom: Beſides, it is the lighteſt of all Liquors; for fill any Veſſel with twenty Ounces of Oil of Vi-

triol,

triol, the ſame emptied, will contain but ſeven Ounces of Æther. It is the very Ens, or Being moſt pure of Flame; wherefore neither Soot nor Aſhes are ever found upon its Deflagration. (*Succeeded.*)

Thus far Dr. Frobenius; *but to make this Paper more than a meer Harangue, it is abſolutely neceſſary to ſubjoin two Paragraphs out of a Paper of that excellent Chymiſt Mr.* Godfrey, (*Dr.* Frobenius's *Fellow Labourer*) *in theſe Experiments which he delivered in when this Æther was made publick before us.*

" *Feb.* 19th, 1729-30. That this Liquor Æthereus,
" was formerly very much eſteemed and enquired into,
" doth clearly appear by an Experiment I made for-
" merly for my worthy Maſter, Eſq; *Boyle*,
" by the Means of a metallick Solution, namely, by
" the Solution of crude Mercury united with the
" *Phlogiſton Vini*, or other Vegetables, and this
" Æther ſwam on Top of the Solution which I ſepara-
" ted *per Tritorium*. *Note*, This is what I have
" done formerly in Eſq; *Boyle*'s Laboratory, and Sir
" *Iſaac Newton* was very well acquainted with it
" too; which by reaſon of Shortneſs of Life was not
" brought to a full End, to do it ſo readily in Quanti-
" ty. But when Dr. *Frobenius*, by Experiments on
" this in my Laboratory, did produce it in greater
" Quantity, he wanted to ſee how far Sir *Iſaac*
" *Newton* had gone on with it in his Book. There
" we ſaw that great Man's Application in Fol. 330,
" that he had done it *cum Ol. Vitr. & Sp. Vin.*

This

This of Sir Iſaac Newton, *is the* Vini Æthereus, *only there is a Difference in the Proceſs: The Liquor* Æthereus *is made with equal Parts in Meaſure, not Weight. The upper yellow Liquor is ſeparated from the inardent ſulphureous* per tritorium. *The inferior Liquor is thrown away; and the ſuperior yellow is put into a Retort to be diſtilled with the moſt gentle Heat; and the Extraction of the Æthereal Liquid continued ſo far until the ſuperior Hemiſphere feels cold, and the Retort being clapped in the Hand, there is found in the Receiver* a Vino-ſulphureous Gaſ. *very Æthereal. Let the Sulphur be precipitated by adding an* Alkali, *and gently throwing it in till all Ebullition ceaſes, and the Liquor will not farther ſtrike it ſelf againſt the Hand, but will ſtrangely attract it. Then the* Alkali *will go to the Bottom of itſelf, or precipitate it ſelf in the common Water.*

POSTSCRIPT.

I *Have purpoſely omitted giving the Receipt entire, which Mr.* Godfrey *has done in the next Paragraph; as alſo Dr.* Frobenius *in his Paper, becauſe thoſe who would read this Tranſaction may refer to the Learned Author for it. And as for others who may chance to caſt their Eye upon this Paper, they will know where to have enough of it, by reading Mr.* Godfrey's *laſt Paragraph.*

IX. *An Account of the* Hermaphrodite Lobſter *preſented to the* Royal Society *on* Thurſday May *the 7th, by Mr.* Fiſher *of* Newgate-Market, *examined and diſſected, purſuant to an Order of the Society. By* F. Nicholls, *M. D. Præl. Anat. Oxon. F. R. S.*

THE World has frequently been amuſed with Appearances proper to both the Sexes, in Perſons who have from thence termed themſelves *Hermaphrodites:* But ſuch of them as have paſſed a more ſtrict Examination, have proved, that thoſe Appearances were either morbid Caſes, or præternatural Formations of the Parts proper only to one Sex. Thus an elongated *Clitoris* has paſſed for a *Penis*, and *ſteatomatous* (or other) Tumors of the *labia pudendi* have been thought *Teſticles*, while the ſubjacent *Vagina* has been the only Proof of the Exiſtence of the Parts proper to both Sexes in the ſame Subject. So that at preſent the Exiſtence of præternatural Hermaphrodites ſeems univerſally denied. Nor is it eaſy to conceive, how an Hermaphrodite can be formed in a Species whereof each Sex has the Parts ſubſervient to Generation, ſingle and neceſſarily ſituated in the ſame Parts of the Body; at leaſt without either a very remarkable Mal-formation of the Body in general, or ſo perverted a Situation of thoſe Parts, as muſt very much impair their Uſes.

But in thoſe Animals whoſe Parts of Generation are double and independant on each other, as the Lobſter, Crab, and many Birds, the Parts proper to both Sexes may poſſibly be formed in the ſame Subject without Prejudice to their Uſes: But in that Caſe the ſeveral Parts can be but ſingle; and conſequently, the Subject

Fig. 1.

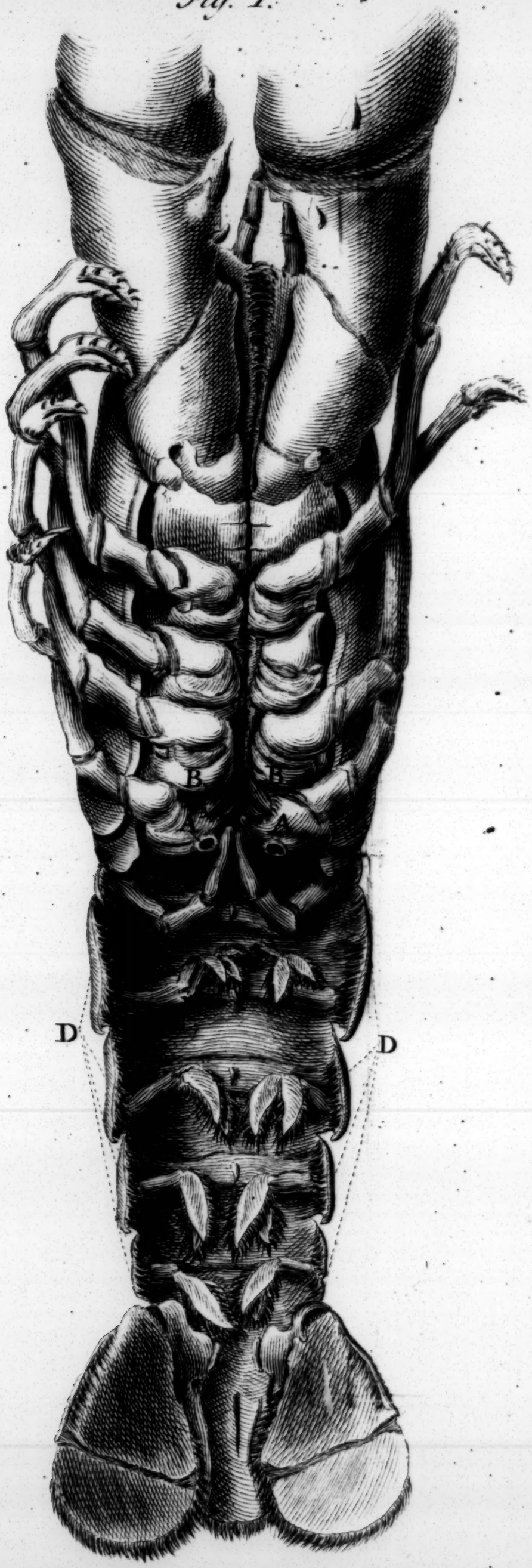


Fig. 2.

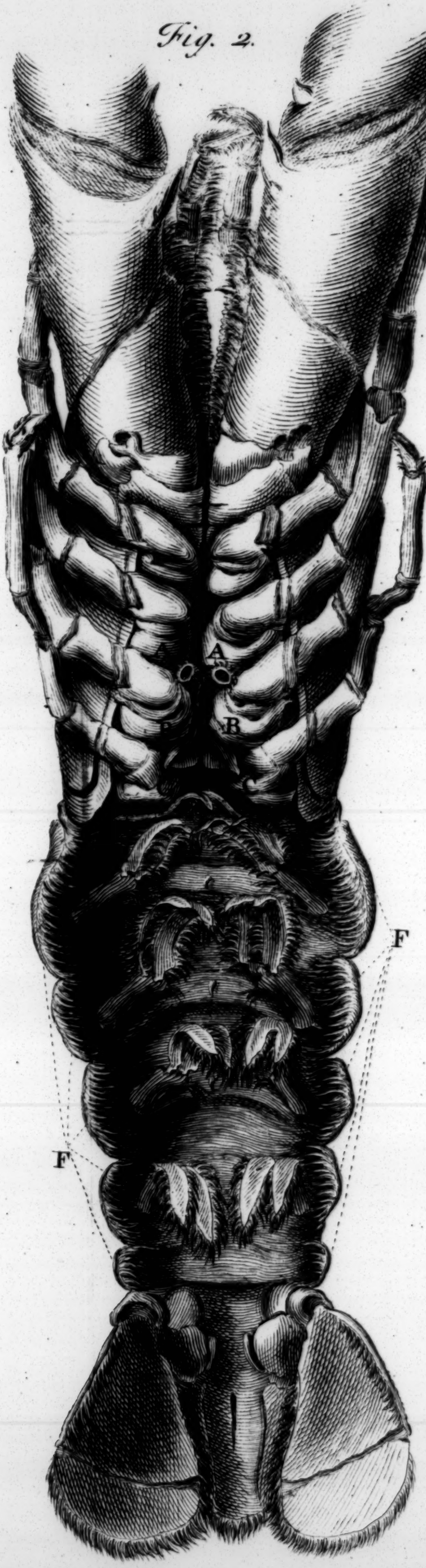
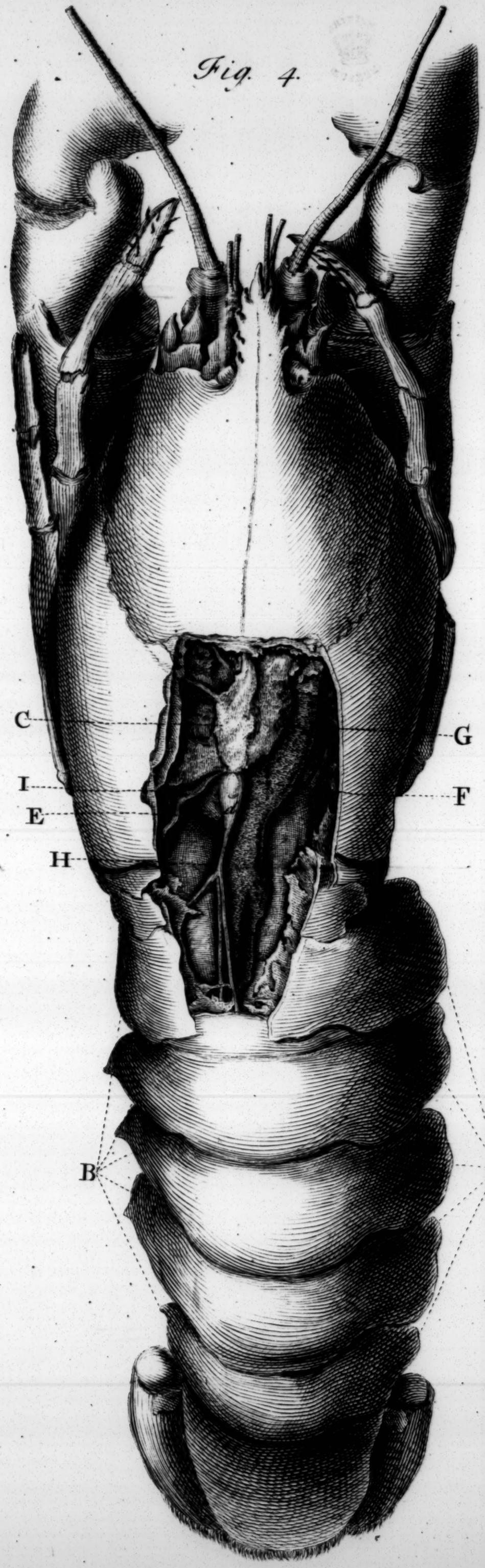


Fig. 3.



Fig. 4.



ſo formed cannot be termed perfect as to its Species, in regard to either Sex, though it may be perfectly of both Sexes ſo far as regards Generation.

Under this Idea of an *Hermaphrodite*, I may venture to ſay, the Lobſter referred to my Examination is truly one; and, if ſplit from Head to Tail, is Female on the right Side, and Male on the left Side.

In Order to illuſtrate this, I ſhall give a ſhort Account of the Structure of the male and female Lobſter, ſo far as relates to the Difference between the two Sexes, and then proceed to ſhew in what Manner they were combined in the Subject before you.

It has already been obſerved that the Lobſter, both male and female, has all the Parts of Generation double, except that the female has one Paſſage only, through which it is probable the *Ova* are emitted out of the Trunk, in Order to be affixed to the ſmall Appendages under the Tail.

The *Penis* of the male Lobſter ariſes from the Teſticle, and is no more than a Continuation of the *Vas deferens*; it is reflected and retored once, after which it grows thicker, as to its Subſtance (probably forming a *corpus cavernoſum*) and terminates, not in the laſt Leg but one, as *Willis*, in his Treatiſe *de Animâ Brutorum* has obſerved, but at a ſmall perforated Tubercle in the firſt Bone of the laſt Leg. *See Fig. the 1ſt*, A A, *the two* Penes.

Between the two laſt Legs and the two Legs above them are two Proceſſes, which, from their reſembling the *Nymphæ* of Women, I ſhall term *Nymphæform* Proceſſes. Theſe Proceſſes are covered with Hair, and unite at their Baſes without leaving any Paſſage. *Fig. the 1ſt*, B B, *the two Nymphæform Proceſſes.*

Below the two laſt Legs, towards the Tail, are two Appendages, which, from their Similitude, I ſhall

term the *ſtyliform Appendages*. Theſe in the Male are thick, hard, and void of Hair. *Fig. the* 1*ſt*, C C, *the two ſtyliform Appendages.*

The Tail is continued from the Trunk in a gradual Decreaſe of its Dimenſion, and is covered by Plates, which extend themſelves but little below the Subſtance of the Tail, and terminate in acute Angles, without any Ways diverging. *Fig. the* 1*ſt*, D D, *the Terminations of the Plates.*

It is to be obſerved, that ſometimes theſe Plates are edged with ſhort and thin Hair, and ſometimes have no Hair.

The Female on the other Hand, in the Place of the Teſticle has an Ovary, which, like the Teſticle, extends itſelf from the Stomach to near one half of the Tail. From the Middle of the Ovary a Duct deſcends to the Legs, which opens at a round Hole edged with Hair in the firſt Bone of the laſt Leg but two: This is the *Uterus*. *Fig. the* 2*d*, A A, *the Entrance into the two* Vaginæ.

The two Proceſſes, which I have termed *Nymphæform*, in the Female make a more obtuſe Angle at the Union of their Baſes; are leſs hairy, and leave a Paſſage, through which it is probable the *Ova* are emitted, to be affixed to the Appendages under the Tail. *Fig. the* 2*d*, B B, *the two Nymphæform Proceſſes*; D, *the Paſſage for the* Ova.

The two ſtyliform Appendages in the Female are ſoft, thin, and edged with long Hair. *Fig. the* 2*d*, C C, *the two ſtyliform Appendages.*

The Plates covering the Tail are extended much farther under the Tail than in the Males, beſide which they diverge, in order to leave a greater Space for containing the *Ova*; for the better Defence of which they terminate broad, and are edged with thick and long Hair. *Fig. the* 2*d*, F F, *the Terminations of the Plates covering the Tail.*

In

In the *Hermaphrodite Lobſter* I found all theſe Parts proper to both Sexes regularly diſpoſed, but in ſuch Manner that the Parts proper to the Female were to be found only on the right Side, and the Parts proper to the Male only on the left Side.

In the antepenultimate Leg the *os uteri* was very obvious on the right Side, as in the Females, but had not the leaſt Mark of any ſuch Paſſage in the ſame Leg on the left Side. *Fig. the* 3*d*, A, *the* os uteri *only on the right Side.*

The *Nymphæform Proceſs* on the right Side made an obtuſe Angle at its Inſertion into the Body, and was ſoft and perforated as in the Females, while the correſponding Proceſs made a leſs Angle, was more hairy and rigid at its Baſis, as in the Male. *Fig. the* 3*d*, B, *the right Nymphæform Proceſs*; C, *the left Proceſs.*

The *ſtyliform Proceſs* on the right Side was ſoft, flat, and edged with Hair, as in the Female; but on the left Side it was ſtiff, hard, and void of Hair. *Fig. the* 3*d*, D, *the right ſtyliform Proceſs as in the Female*; E, *the left ſtyliform Proceſs, as in the Male.*

In the laſt Leg on the left Side the perforated Tubercle for the Paſſage of the *Penis* (as in the Male) was very conſpicuous, but without the leaſt Appearance of ſuch Tubercle in the correſponding Leg on the right Side. *Fig the* 3*d*, (H) *the perforated Tubercle for the Paſſage of the* Penis.

The Plates covering the Tail were extended on the right Side conſiderably below the Subſtance of the Tail, and were edged with thick and long Hair, and terminated broad, as in Females. *Fig. the* 3*d*, F, *the Termination of the Plates covering the Tail.*

On the left Side, theſe Plates were much leſs extended below the Tail; were almoſt totally void of Hair, and terminated in acute Angles. *Fig. the* 3*d*, (G)

the

the Termination of the Plates covering the Tail on the left Side.

Theſe Plates diverged likewiſe on the right Side, as in the Females, but not on the left Side, as in the Males. *Fig. the 4th*, A, *the diverging of the Plates on the right Side*; B, *the Plates no Ways diverging.*

Upon removing Part of the great Shell, I found the internal Parts of Generation in both Sexes exactly correſponding to thoſe externally deſcribed.

In the right Side adjacent to the Heart, the *Oviduct* was regularly diſpoſed, it was full of *Ova*, and ſent off its *Oviduct* or *Uterus*, to the antepenultimate Leg. *Fig. the 4th*, F, *the* Ovary; G, *the* Oviduct *or* Uterus *leading to the antepenultimate Leg.*

In the left Side the Teſticle was rightly diſpoſed as to its Form, Subſtance, and Situation; Part of which I was obliged to remove, in Order to ſhew the *Penis*, which terminated as in all Males, at the Tubercle in the firſt Joint of the laſt Leg. *Fig. the 4th*, E, *the* Penis; I, *Part of the Teſticle unremoved.*

I had ſome Thoughts of removing ſo much of the great Shell as was neceſſary to ſhew the Courſe and Terminations of the *Uterus* and *Penis*, at their proper Orifices. But conſidering that by that Means the Tail would too eaſily ſeparate from the Trunk, and the Appearances of the other Marks be rendered leſs obvious, I choſe only to lay them open at the Back, believing that to be ſufficiently ſatisfactory to thoſe who underſtand the Structure of that Animal. I have ſteeped it in three different Spirits, and carefully diſpoſed it in a Glaſs, which I have ſtopped in the beſt Manner I can, that it may remain in the Repoſitory, as an undeniable Proof of ſo remarkable a Fact.

F I N I S.

Numb. 414.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *May*, *June*, *July* and *Auguſt*, 1730.

The CONTENTS.

I. *Magnetical Obſervations and Experiments*; *by* Servington Savery, *Eſq*; *of* Shilſton.

II. *An Eſſay upon the Uſe of the* Bile *in the Animal Oeconomy, founded upon an Obſervation of a Wound in the* Gall-Bladder. *By* Alexander Stuart, *M. D. Phyſician in Ordinary to her Majeſty, Fellow of the College of Phyſicians, and of the Royal Society.*

III. *Obſervatio Lunaris Eclipſeos, Ulïſſipone habita die* 2 Februarii, An. 1730, N. S. *in Collegio Divi* Antonii *magni à Rev. P.* Joanne Baptiſta Carbone, Soc. Jeſ. *Ex ejuſdem Cl. Viri Epiſtola ad* Jacobum de Caſtro Sarmento, *M. D. Coll. Med.* Lond. Lic. *& R. S. S.*

[V. *Ob-*

The CONTENTS.

IV. *Obſervationes Cœleſtes Multifariæ inter Menſes* Novemb. 1727, & Novemb. 1728, Pekini *in* SINIS *habitæ, & ad Rev.* P. Joannem Baptiſtam Carbone, *Soc.* Jeſ. *tranſmiſſæ. Ex eadem Epiſtola deſcriptæ.*

V. *An Account of the Veins and Arteries of* Leaves. *By* Frank Nicholls, *M. D. Præl. Anat.* Oxon. *F. R. S.*

Jos: Banks

I. *Mag-*

contra, &c.

Fig. 11.

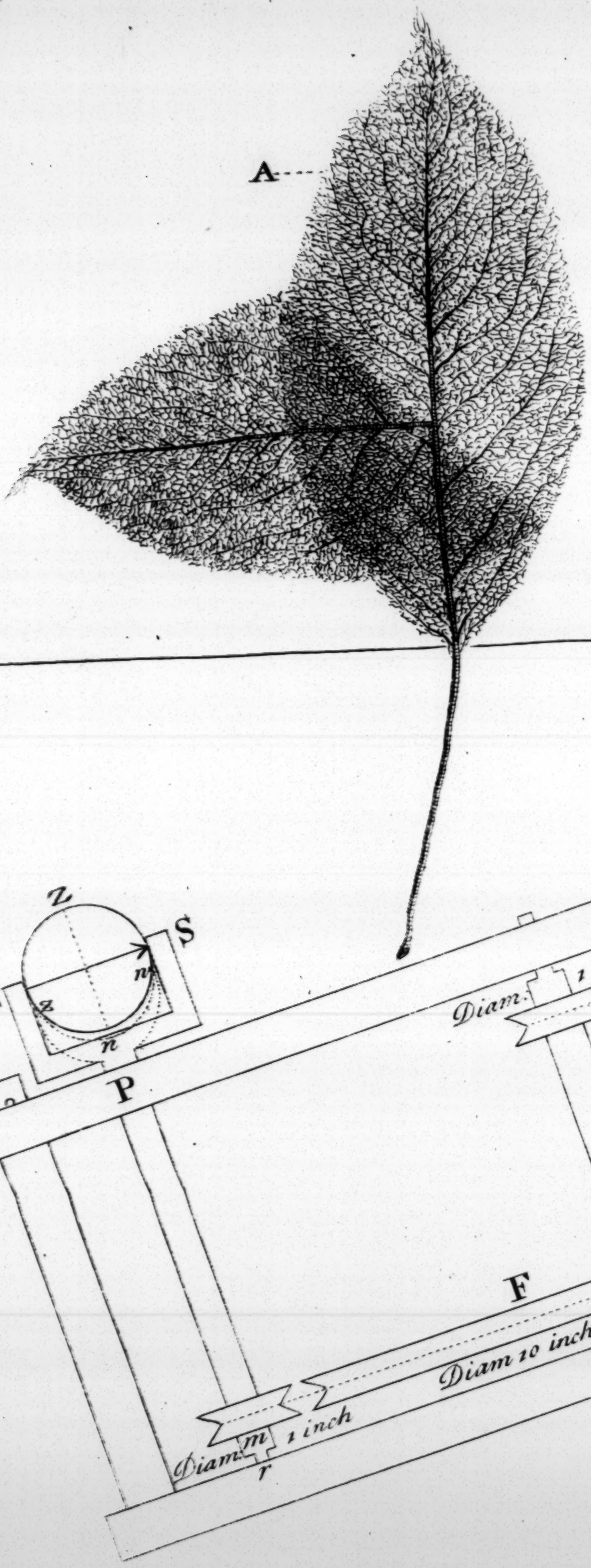
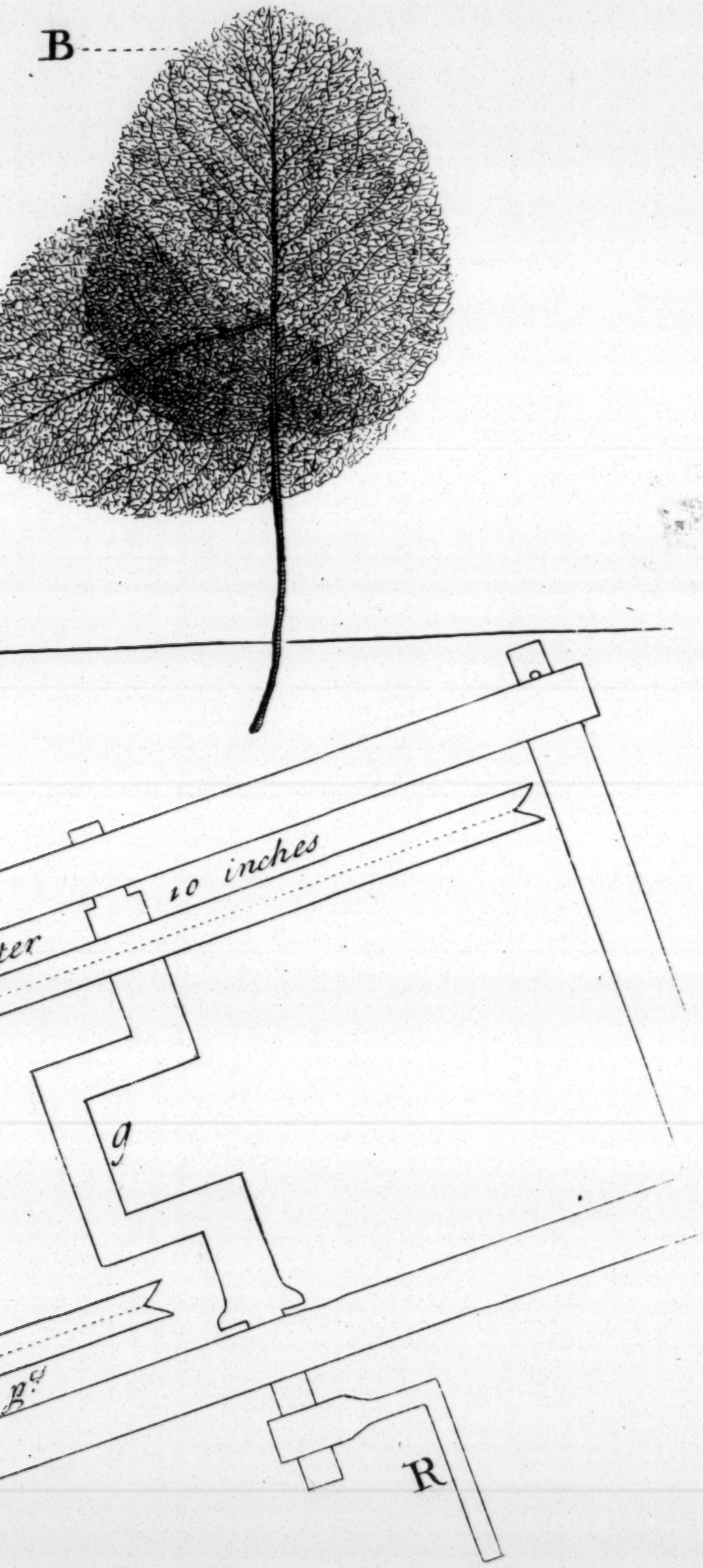
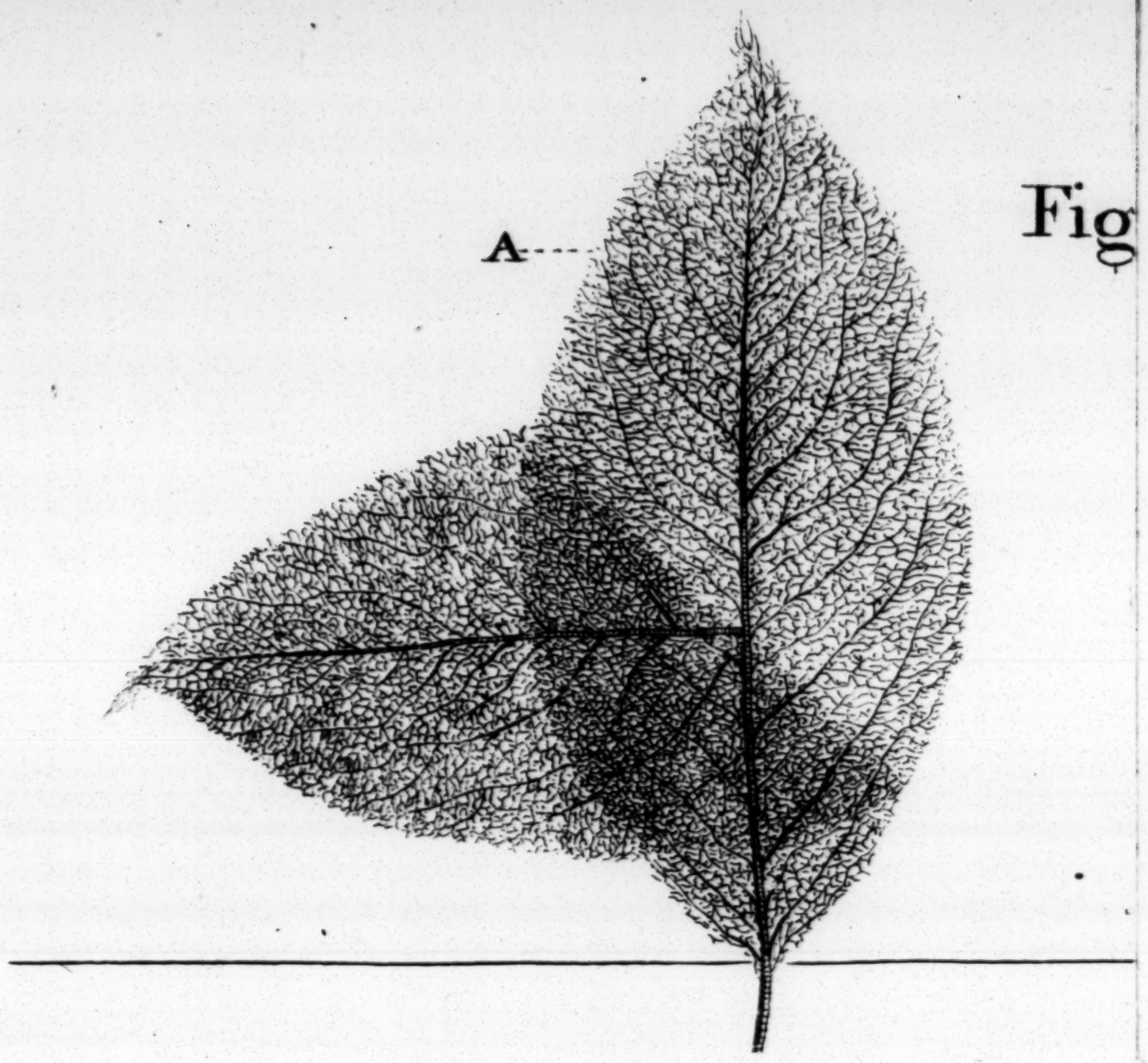

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Fig



I. *Magnetical Obſervations and Experiments*; *by* Servington Savery, *Eſq*; *of* Shilſton.

PRECOGNITA.

I. THAT which I call the Magnetical Line, is the Poſition of a Dipping-Needle when it ceaſeth from oſcillating, and is at Reſt in the magnetical Meridian of the Place.

II. By the Word Magnet (unleſs diſtinguiſhed) I would be underſtood to mean not a Loadſtone only, but either that, or Iron or Steel, when they have permanent Polarity, or any thing elſe (if to be found) which has a ſenſible magnetical or polar Attraction.

III. Of the magnetical Needle, I always call that the North End which (if hung horizontally) naturally turns to the North, and that the South End which turns to the South: But when I uſe the Words Pole of a Needle, I call that the North Pole thereof which turns to the South, and that the South Pole of it which turns to the North.

IV. Of Touched Iron or Steel (or of Untouched, ſo long as it remains in a Poſture which gives it Polarity) as well as of the Loadſtone itſelf, I call that the North Pole which attracts the North End (*i. e.*) the South Pole of the Needle, and that the South Pole which attracts the South End, or North Pole of the Needle: Or in other Words, I call that the North Pole, in all Sorts of Magnets, which is endued with the ſame kind of Vertue which the North Pole of the Earth hath, and conſequently is repelled thereby: *E contra*, &c.

V. I prepared Nails of ſeveralSizes, from the ſmalleſt Sort of Bellows-Nails to the largeſt Sort of Rafter-Nails, one or two of each Sort, or more of the ſmaller: I held each of them perpendicularly with its Point upwards, and placing thereon the plain Side of a File horizontally, I filed off a little from the Point thereof (more or leſs according to the Size of the Nail, perhaps about the Thickneſs of a Six-pence from a Six-penny one). Then on a plain Hone, held horizontally, I placed the Nail upright, with its Point downward, and ſo rubbed off the Strokes of the File. Then I rubbed it a little on a Piece of Leather. *Note*, The truer this little narrow Plain is, and more exactly perpendicular to the Nail's Axle, the better.

VI. I prepared Iron Bars of different Lengths after the following Manner: I made each End in the Shape of the lower Fruſtum of a Pyramid, cut tranſverſe to its Axis about the Middle, or a little higher up. Then I filed the Ends of the Bar as plain and perpendicular to its Axis as I could, and poliſhed them with a Hone, *&c.* as I did the Nails. *See the Figure.*

VII. One of the Needles I uſed untouched, for trying Experiments, was made thus: I took ſome Iron Wire, about the Size of a ſmall Knitting-Needle, and in Length about two Inches and a half. With a Hammer I made it juſt flat enough in the Middle, to be able to fix the Point of a Punch pointed, to as true a Cone as I could; its Sides (as I gueſs) made an Angle with each other at the Vertex of about 45 Gr. or more; in the Middle of the Wire I punched a Hole at leaſt

half

half Way through the Thickneſs thereof, and wrought the Hole with a Drill (pointed like the Punch) that it might be truly round, and cleanſed off the Aſperity which the Punch and Drill had raiſed round the Hole, leſt it ſhould injure the Top of the Pin when it was placing thereon. Then I bended it in this Form,



taking Care to bend it the right Way, that the Hole might be on the under Side. Then I marked one End, by flatting it a little with a Hammer, that it might be known from the other. Then placing it on a ſharp Pin, to find which End was heavieſt, I made both alike in Weight, and deprived it of all fixed Magnetiſm. Then I brought it again to as true a Poiſe as I could, by rubbing the heavieſt End on a Whetſtone, and not a File, which might give it Magnetiſm again. I fitted a Pin for it of braſs Wire, full ſo ſmall as the middle Strings of a Spinnet, making the Point very meagre and round as well as ſharp, and obſerved it frequently with a Lens of two Inches Focus; and if it appeared flat, I mended it on a Hone, and took great Care in putting on the Needle, not to hurt the tender Point of the Pin. I put a Glaſs over it, to keep off all manner of fanning by the Air, the leaſt Degree whereof did ſpoil the Experiments.

VIII. A ſecond Needle, which I thought better than the former, I made thus: In the middle of ſuch a Piece of Wire as the former was made of, I wrought a Hole through it as perpendicular as I could to its Axis, or Length, and ſo ſmall as any of thoſe which are drilled through the Pillars of a Watch, if not ſmall-

ler. And having bended the Wire in this Form,

I marked one End thereof, and drove into the Hole a ſmall braſs Pin fitted to it, which was very round and ſharp at the Point, which reſted on a deep Plano-Concave Lens of Glaſs well poliſhed. (*See the Figure.*) I fitted a Box for it with a Glaſs over it; which Glaſs was faſtened with a Ring of braſs Wire, as the Glaſſes of Teleſcopes are; which Ring kept out Air, otherwiſe had been needleſs. The Glaſs Concave was fixed in the great End of a thin Braſs Ferule (like that off a Staff) juſt fit for it, and the ſmall End of the Ferule was fixed in a Hole made for it in the Middle of the Bottom of the Box: I alſo put a Ring of thin Braſs on the Top of the Lens, not only to keep it in ſteady, but to prevent the Pin from going in betwixt the Lens and the Ferule, which ſpoils its Point. Doubtleſs a Concave of Diamond is much better.

Whenſoever I uſed one of either Sort of theſe Needles (eſpecially for ſuch Experiments as required it to be perfectly void of fixed Polarity) I was obliged to keep it in a Motion either librating up and down like the Beam of a Pair of Scales, or trembling (which is a ſhort pendulous Oſcillation from Side to Side) or elſe both librating and trembling at the ſame Time; which ſaid two Motions being at right Angles with each other, are not inconſiſtent: And if the Needle is truly poiſed, the horizontal Verticity is neither obſtructed nor accelerated by the Librations, becauſe they are at right Angles thererewith, nor by the Tremblings, becauſe the two Ends perfectly balance one another in contrary Motion.

tion. The Service they do, is to abate that Friction on the Pin's Point, which retards the horizontal Verticity; for when the Friction is divided between the horizontal Verticity, and the Librations or Tremblings (either of the two latter rolling on the Pin more ſpeedily) the far greater Part of the Friction is ſpent on the Librations, or Tremblings, and conſequently there is but little left to retard the horizontal Verticity. I take ſuch a Needle to be far better for my Purpoſe than the common ones, which have a heavy Socket of Braſs, or Steel, in the Middle, uſeful only to render them portable, but very detrimental in nice Experiments; becauſe the Weight of the Socket not only blunts the Pin ſooner, but alſo encreaſeth the Friction, though the ſame Acuteneſs of the Pin ſhould be ſuppoſed to continue. To renew the Tremblings when they began to abate, I rarely jogged the Box on the Table, for fear of giving it (and the Needle within it) a circular Motion, which obſtructs the Deſign: But I found it beſt to do it, by jogging the Table gently. When I had Occaſion to turn the Needle to any other Point of the Compaſs, I elevated that Part of the Box which was under one End, until it reſted on the Bottom, and in that Poſture could turn it as I would; but before I could let down the Box again to an horizontal Poſition, was forced to wait till the Needle was very ſtill, and to let down the elevated Side eaſily, and with a direct Motion; otherwiſe the Needle, as ſoon as both its Ends were free, would have more or leſs of an horizontal Motion.

Moſt

Moſt of the known Properties of all Sorts of Magnets which have been diſcovered by the Obſervations and Experiments of ſeveral Perſons, including one or two of my own, are the following.

I. THAT the Loadſtone, by an inviſible Force which differs from that of Gravitation, and alſo of Electricity, draws unto itſelf Loadſtone, Iron, and Steel; and with the ſame Kind of Force, or Power, does not (at leaſt very ſenſibly) attract any other Body whatſoever.

II. That the Loadſtone attracts Loadſtone, Iron and Steel with a polar Attraction; and that whatſoever Attraction is not polar, is not magnetical.

III. That the two oppoſite Parts of a Loadſtone attract moſt vigorouſly, and are called the Poles thereof. The Middle between its two Poles doth not attract at all, and may be called its Æquinoctial; and from either Pole to the Middle, the attracting Force does gradually abate.

IV. That in the ſame, and every Loadſtone, the one of its Poles is in Vertue (or rather in Direction) contrary to the other, and therefore they need to be diſtinguiſhed from each other; which is done by adding North or South. The North-Pole of one Loadſtone will not attract, but repel the North Pole of another, though they are poſſeſſed of ſimilar directive Vertue; neither will the South Poles of any two Loadſtones attract, but mutually repel one another: But the North Pole of one Loadſtone, and the South Pole of any other, do mutually attract each other; and though their directive Vertue is contrary, yet the unknown Cauſe of their Attraction and Repulſion ſeems to be the ſame.

V. That

V. That there is no Difference (at leaſt I could never find it) between the Force or Strength of Attraction and that of Repulſion in the ſame Pole of any Loadſtone or Magnet, unleſs when a ſmall one approaches ſo near to a large one, as to have its Polarity more or leſs diminiſhed thereby.

The preceding Properties convince me, that there is no ſuch thing in Nature as magnetical Attraction without Polarity, which is conſtituted of Attraction and Repulſion; and theſe two Powers being always equally ſtrong in the ſame Pole of every Magnet, I take it to be a plain Contradicton, to ſay this or that Loadſtone has a ſtrong Attraction, but a weak Polarity or Direction.

VI. That no interpoſed Body whatſoever (unleſs it is magnetical) though the moſt ſolid in Nature, was ever known in the leaſt to impede or divert any of the Effects of a Magnet; but it is always found to attract magnetical Bodies full ſo powerfully at the ſame Diſtance, as if nothing at all was between.

VII. That every Fruſtum of a Loadſtone is an entire or perfect Loadſtone, having in itſelf both Poles as the whole Stone had; and that the Poles in each Fruſtum have their Direction (as near as the Figure of it will admit) in the ſame parallel Line wherein they were directed both in it and the whole Stone, before it was ſeparated therefrom: For the Polarity of every Fragment is uſually, if not always (before they are ſeparated) parallel to that of the whole Stone, and conſequently to that of each other: And if ever it is found otherwiſe, I cannot but think that Loadſtone wants of Perfection.

Let

Fig. 1.

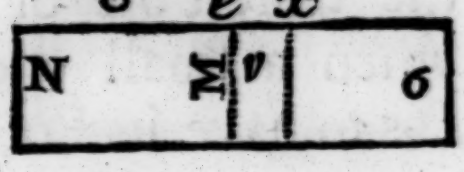
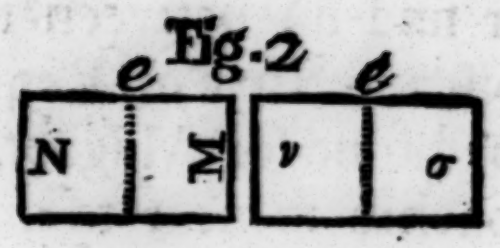


Fig. 2



Let N Σ ν σ, *Fig.* 1*ſt*, be a Loadſtone in the Form of an oblong right-angled Parallelopipedon, whoſe Polarity is Length-ways, N being its North Pole, *e*, the pricked Line, its Equinoctial (or Middle betwixt its Poles) where it has no Attraction, and σ its South Pole. Let it be biſſected at *e*, tranſverſe to its Polarity, or Length. Each of its Fruſta (repreſented *Fig.* 2.) when they are placed too remote to act on each other) will infallibly be poſſeſſed of both Poles (with its Equinoctial in its Middle) as the whole Stone was before its Biſſection: And though originally the one Fruſtum N Σ was all over a North Pole, and the other ν σ all over a South Pole, while they adhered to one another, yet now they are divided, and placed beyond the Reach of each other's Vertue, one half of the Fruſtum N Σ from the Place of its *quondam* Contact Σ, to its Middle *e*, does inſtantly become a South Pole, and attract ſtrongly at the Place of Contact aforeſaid, which Attraction is gradually leſs and leſs until it is abated to nothing at *e*. So alſo one half of the Fruſtum ν σ, from the Place of its former Contact ν to its Middle or Equinoctial *e*, inſtantly becomes a North Pole (gradually abating in Strength from ν to *e*) though the whole Fruſtum, before its Separation from the other, was a South Pole: The Polarity being alſo directed the ſame Way in each Fruſtum that it was in it (and the whole Stone) be-

fore

fore the Biſſection. The Caſe alſo would have been the ſame, if the Stone had been divided unequally at *x*, or elſewhere tranſverſe to its Polarity, *Fig.* 1*ſt*, and of each Fruſtum, one half would have been a North Pole, and the other half a South one, with its Equinoctial in the Middle as before. The whole Stone will lift a larger Iron than either Fruſtum; but both Fruſta, while out of the Reach of one another's Vertue, will each of them lift his Iron, both of which Irons will be heavier than what the whole Stone could lift before it was divided. If the ſaid Fruſta are again joined cloſe together at the ſame Ends which originally adhered, *Fig.* 1*ſt*, being as they ſtand directed towards each other *Fig.* 2*d*; or if the oppoſite Ends of both are joined together, as they ſtand directed towards each other, *Fig.* 3*d*, I do not ſee (provided the

Fig. 3.



Fig. 4.

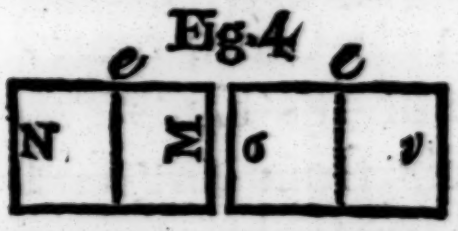


Fig. 5.

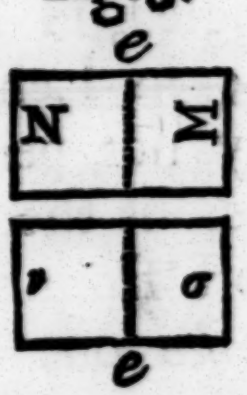


Fig. 6.

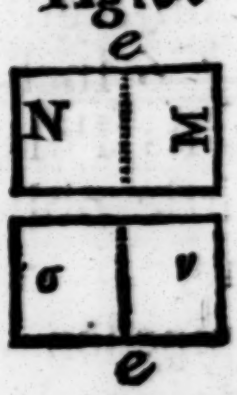


Fig. 7.



Joint is very good, that there may be a Contact all over it ſo good as a Workman can make) why they ſhould not compoſe again one entire Loadſtone, ſo good as it was before it was divided, in all Reſpects (Allowance being firſt given for the Waſte in ſawing it aſunder, and mending the Joint) and their joined Poles mutually attracting one another, attract nothing elſe at the Joint (which being in the Middle, would become

its Equinoctial) but tranſmitting their Vertue through one another, the Pole Σ of the one Fruſtum, *Fig.* 2*d*, wholly ſpends itſelf in ſtrengthening the ſimilar Pole σ of the other Fruſtum, by weakning the Pole ν thereof, *& vice verſâ.* And if their Lengths ſhould be unequal, like the Fruſta of *Fig.* 1*ſt*, divided at *x*, the Equinoctial would not be at *x*, where they were joined together again, but always at *e* the Middle of their whole conjunct Length, as it uſeth to be in one entire Loadſtone of the ſame Bigneſs from Pole to Pole: For I apprehend if any Loadſtone ſhould be wrought very Tapering from one Pole to the other, that the Equinoctial could not be preciſely in the Middle thereof, but according to what Degree of Taperneſs it is wrought to, be removed nearer to the great End: But theſe Things, for want of proper Loadſtones, I cannot try, nor yet the following on *Fig.* 7*th*, which repreſents a Loadſtone in the Form of a Parallelopipedon right angled, in Thickneſs one Inch, its Breadth *a f* 6 Inches; its Length *a c* 7 Inches or more, having its Polarity not perfectly length-ways in it, but a little oblique, as the Shade-Lines repreſent it. If there is cut off from one of it's Ends *c d*, the Parallelopipedon *b c d e* one Inch from the ſaid End, it will be one Inch ſquare, and ſix Inches long: I ſuppoſe this leſſer Fruſtum would have its Polarity changed, and the Direction thereof, inſtead of running from *e* ſomewhat towards *d*, would run from *e* towards *c* in the Diagonal Line *e c*, or in ſome Line or other between the Lines *e b* and *e c*. I alſo imagine, that if a Cube was cut off, within a little Time after, from one End, the Polarity therein would be directed as it was therein, while all the ſaid Fruſta adhered toge-

together; but if the leſſer Fruſtum *b c d e* ſhould long remain ſeparated from the whole Stone, before the ſaid Cube was cut off, that the Polarity of the Cube would be more or leſs fixed, and conform itſelf more or leſs to the Direction of the Line *e c*. However, this is certain, that if the two Fruſta are joined together, as they ſtand directed *Fig.* 2, or *Fig.* 3, with the North Pole of one to the South Pole of the other, they aſſiſt one another in lifting Iron. If joined *Fig.* 4*th* with the South Pole of one againſt the South Pole of the other, by repelling they reciprocally deſtroy each other's Vertue, and alſo hinder one another's Attraction at the North Poles, which are not joined. If they are placed together, as in *Fig.* 5*th*, though they endeavour to avoid one another, yet they do not deſtroy each other's Vertue ſo much as in the preceding Caſe, nor yet at all if there is a perfect Contact: For if this Poſture of two Magnets actually adhering would diminiſh their Vertue, one Part of the ſame Loadſtone would deſtroy another Part of itſelf, and in a very ſhort Time there would be no ſuch Thing as Magnetiſm. In this Poſture they mutually help one another's Attraction, becauſe their Polarities are directed the ſame Way. If they are applied, as in *Fig.* 6*th*, with their Sides together, and their Polarities contrarily directed, the North Pole of the one (at either End) attracting the South Pole of the other, and the South Pole the North, they ſcarcely injure one another's Vertue by ſo lying together, but hinder each other from attracting other Things, by ſpending their Vertue on each other.

VIII. That all magnetical Attraction (as alſo Repulſion) is mutual; for Iron or Steel attract the Load-

 ſtone,

ſtone, as that does Iron or Steel, and they alſo one another.

IX. That every Loadſtone communicates Vertue to Iron or Steel, not only by Contact, but even by an Approach of them within its attractive Sphere, more or leſs as nearer to, or farther from its Body; and likewiſe its Poles, alſo according to the Shape, Bulk and ſpecifick Vertue thereof, and Figure of the Iron or Steel, and their Proportion of Magnitude to one another. I apprehend, that though a great Magnet (I mean of ſuch as are ſimilar in Figure and ſpecifick Vertue) will lift conſiderably larger Irons than a ſmall one, yet the ſmall one ſhall give to the ſame Piece of Steel (provided it is not too large for it to conquer) well nigh (if not altogether, as to Senſe) ſo ſtrong a Touch as the great one. And I have experienced, that if the ſmall one is ſpecifically pretty much better, it will give the ſame ſmall Piece of Steel a conſiderably ſtronger Touch than the great one can, though the great one is capable of lifting perhaps three or four Times ſo much as the ſmall one. *Note*, That if the great one is ſo ſtrong as to give the ſmall Piece of Steel ſo much Vertue as it is capable of receiving (for there is, I ſuppoſe, a *ne plus ultra*) that then ſhould the ſmall Stone be ever ſo much better, it cannot mend the Touch given by the great one. Some write, that the Loadſtone loſes none of its Vertue by communicating of it to Iron or Steel, which I ſomewhat doubt the Truth of, eſpecially if the Stone is ſmall in Proportion to the Steel, in which Caſe I have known touched Steel loſe conſiderable Vertue.

X. That Steel is not only more receptive, but more retentive of Magnetiſm than common Iron; Iron or

Steel

Steel hammered hard, than the ſame while ſoft; but Steel hardened by quenching, than either of them. My Obſervation has been, that Steel cannot be ſeaſoned too hard for Retenſion (nor, as I think, for Reception) of Magnetiſm; but may ſometimes warp too crooked for its intended Uſe, and muſt be made right again ſome Way or other, either with a Grinding-Stone, or (if that will not do) by heating it to a blue Colour, and gently hammering it while hot; but if it can be helped, the Temper for the blue Colour is too ſoft.

XI. It has been obſerved, that oblong Pieces of Iron or Steel applied any how to the Loadſtone, receive Vertue chiefly (ſome ſay only) as to their Lengths. This was what induced me to explain *Fig. 7th*, in the Middle of *Pag.* 304. For I think it a parallel Caſe with this here, and ſuppoſe that the Vertue may incline to run length-ways even in the Loadſtone itſelf. However, I think if it muſt be allowed to be length-ways, it is ſometimes found to be very irregular in pretty long Pieces, as North Pole againſt North Pole, South Pole againſt South Pole ſeveral Times in the ſame Piece, which ſeveral contrary Polarities have been obſerved by ſeveral in Wires, and I have ſeen in a round Bar (of which Irregularity, and the Method of curing it, more hereafter) But ſuch contrary Polarities ſeem unaccountable.

XII. That ſuch Iron and Steel as has magnetick Vertue communicated to it, does alſo communicate thereof to other Iron or Steel after the ſame Manner a Loadſtone does. Which Vertue, after never ſo many Communications, is, as to its Nature, perfectly the ſame with that of the Stone itſelf, having both Poles,

and will touch other Steel, and that a Compaſs, ſo well as the Loadſtone itſelf, and ſo vigorous, if uſed as hereafter is directed.

XIII. That the Earth contains within it, at or near its Center, a Loadſtone or Magnet (probably ſpherical) large enough very ſenſibly to affect magnetical Bodies all over the Surface of the Earth. The Poles of its Attraction are conſiderably diſtant from thoſe of its own, which are the ſame with thoſe of the Earth's Diurnal Rotation. This internal Magnet muſt either be looſe from the Body of the Earth, and revolve within it very little ſlower, or elſe, if it is fixed to the Earth, the very Polarity itſelf muſt have changed its Situation in reſpect of the ſaid Magnet, One, of which, ſeveral recorded Obſervations in diſtant Years ſufficiently prove. The former ſeems moſt probable: However, I imagine (was it not for the Charge and Trouble) an Experiment might be made which would ſhew whether or no it is poſſible in Nature for the Poles of the ſaid Central Magnet to change their Situation in reſpect of itſelf, as well as of the Earth, as will appear when I give the Deſcription of it.

XIV. That every Loadſtone within its attractive Sphere has a Power (the nearer either of its Poles the greater) to keep one Piece of Iron ſuſpended to another, eſpecially if that to which it is ſuſpended is the largeſt, and their Ends be bright and clean, where they touch one another; and if the ſuſpended Iron is not too heavy, the other will draw it up from either Pole of the naked Loadſtone actually touching it, and will alſo keep it ſuſpended, till at a conſiderable Diſtance therefrom; but will not draw it off in

ſuch

ſuch manner from the Armour of unarmed Stone, if the Armour and Iron are both of them bright and clean at their Contact. Hence it muſt follow,

XV. That an armed Loadſtone can lift more with either of its Poles, uſed ſingly, than the ſame can lift naked; and this it will do, though the Armour ſhould be narrow, and touch very little of the Stone; how much more then will it lift, when the plated Part thereof covers all the End of the Stone, and ſecures all the Vertue of that Pole to which it is applied, leading it to the other End which attracts? I take ſoft Iron to be ſo good for Armour as the choiceſt Steel, if not better.

XVI. That not only Steel or Iron regularly touched, but alſo oblong Iron void of permanent Vertue (ſo long as it has a tranſient Vertue by Poſition of either of its Ends towards the Pole of a Loadſtone large enough to affect it at a conſiderable Diſtance) will perform all that any Loadſtone can, though not with the ſame Degree of Power: For either of them will attract, keep one Piece of Iron ſuſpended to another, and communicate ſome Degree of permanent Polarity to Steel well hardened, as I have experienced, and alſo to an Iron Wire.

XVII. That the Earth's central Loadſtone, or Magnet, has all the ſame Vertues which others have, and no diſcovered ones beſides; and though we cannot approach it, yet it acts as others do at a proportionable Diſtance. I have experienced, that it will keep a prepared Six-penny (or with more Difficulty a Ten-penny) Nail ſuſpended to a prepared Iron Bar about $\frac{1}{8}$ of an Inch ſquare, and 5 or 6 Feet long, in an erect Poſture with either of its Ends downwards. I hung up the Bar in a Room

by

by a Loop of ſmall Cord faſtened at the End which was upwards; I then carefully wiped the lower End of the Bar, and the Point of the Nail, that there might be no Duſt, or Moiſture, to prevent a good Contact, taking Care not to touch either of them with my Finger, leſt Perſpiration ſhould ſully them. Then holding the Nail under the Bar very erect, with its Point upwards, I kept it cloſe to the Bar, by only one Finger held under the Head of it, for the Space of 30 or 40 Seconds or more. Then I withdrew my Finger very gently, and directly downwards, that the Nail might not oſcillate; and if it fell off, I wiped its Point as before, and tried it again at ſome other Part of the Plain at the Bottom of the Bar; for I always found it would more readily hang at one Place than another, and uſually the Middle was not ſo well as towards one of the Edges or Corners, and the Succeſs better nigh one Edge or Corner than another. If both Ends of the Bar are equal in Bigneſs, and the Preparation of their Ends ſimilar, it is indifferent which End is downward, if it has no permanent Vertue: But if it has no more than an inchoate or imperfect Degree of fixed Polarity, one End will anſwer better, and the other worſe, in Proportion to the Degree of imperfect Polarity which it has.

XVIII. That of a ſoft Iron Bar void of fixed Polarity, ſo ſoon as it is in an erect Poſition, the higher Part from the Middle upward becomes a North Pole in North, or a South Pole in South magnetick Latitude. And, *e contra*, the lower Part from the Middle downward becomes a South Pole in North, and a North Pole in South Latitude: But ſo ſoon as ever the Bar is inverted, the Polarity will be ſhifted in it,

and

and in North Latitude the End newly placed upward becomes the North Pole, though it was a South one immediately before, and the other End the South Pole, though it was its North one juſt before. The Caſe is the ſame, if ſuch a Bar is placed horizontally in or near the magnetical Meridian; for the End directed toward the North will conſtantly be a South Pole, and that which is directed toward the South, a North one; and ſo ſoon as ever the Ends of the Bar are ſhifted, the Polarity, in reſpect of the Bar, is ſhifted alſo (but not in reſpect of the Earth) for which Reaſon this Vertue is called Tranſient, and is communicated by the Earth's central Magnet in ſuch Manner as other Loadſtones are ſaid to do, *Page* 309*th*, *Prop.* 16*th*.

XIX. Since in North Latitude the North Pole of the Earth's central Magnet not only gives the Vertue of a South Pole to that End of a Bar which is neareſt to it, but alſo helps it to lift Iron when neither the Bar nor Iron lifted has any permanent Vertue; the ſaid Magnet muſt therefore neceſſarily help the South Pole of any Loadſtone or Touched Steel in lifting Iron, but hinder its North Pole. This agrees with common Experience, the North Pole of a Magnet being unable to lift ſo much as its South one in North Latitude, but more in South Latitude.

XX. The preceding plainly ſhews the Reaſon why an armed Magnet, when both of its Poles are applied to a Piece of Iron, will lift ſeveral times ſo much as with either Pole ſingle. For the North Pole of the Magnet, by ſending its Vertue through the attracted Iron, powerfully helps the South Pole of the ſaid Magnet in attracting. Again, the ſtrengthened South Pole

muſt more powerfully increaſe the Attraction of the North Pole: And ſince the Poles mutually aſſiſt one another's Attraction, with a Power much greater than if they themſelves are not aſſiſted, the conjunct Poles muſt neceſſarily lift at leaſt twice ſo much as both of them can lift ſeparately. I once tried, and found the South Pole armed to lift 1125 Grains, and both Poles united 5760 with a little more Difficulty. The Ratio is about 1 to a little more than 5.

XXI. That if a Bar of Iron or Steel (not having the leaſt Degree of fixed Vertue) is placed in any Poſture (except at, or near to a right Angle with the magnetical Line) it will not only for the preſent receive a tranſient Polarity thereby, but if it ſo remains long enough, the ſaid Polarity will gradually become fixed or permanent, more or leſs, according to the Hardneſs or Softneſs of the Bar, Time it has remained in that Poſition, Angle its Length makes with the magnetical Line, and Proportion of the Length thereof to its Bigneſs, the longeſt (*cæteris partibus*) uſually receiving moſt Vertue: And ſometimes when all theſe Advantages concur, the Polarity will be ſenſibly permanent in a little Time, and not require a very long Time to be rendered pretty ſtrong.

XXII. That by placing the ſaid Bar afterwards in the ſame Poſition, only with its Ends ſhifted, it will gradually loſe its gained Magnetiſm, and at length have its Polarity changed.

XXIII. Mr. *Boyle* found one of his Loadſtones much impaired by lying long in a wrong Poſture; I ſuppoſe he meant a repelling one, with its North Pole towards the North Pole of the Earth. Alſo by applying one Pole of a very ſmall Piece of Loadſtone to the

ſame

ſame Pole of a large one, he ſoon changed the Polarity of the former, but could not effect it on a Piece of any conſiderable Bigneſs, though he tried ſome Hours. I have changed the Polarity of a ſmall Fruſtum of Loadſtone ſuddenly, and without a Contact, by holding one of its Poles nigh the ſame Pole of a Piece of Touched Steel much leſs than a common Caſe-Knife, at above $\frac{1}{8}$ of an Inch diſtant, which would make the Fruſtum leap to it. I repeated theſe Changes frequently with the ſame Fruſtum.

From this, and ſome of the preceding Experiments, I conclude, that if two parallelopiped Loadſtones equal in Magnitude and ſimilar in Subſtance, Figure and Vertue, are placed cloſe together as in *Fig. the 4th*, with the North Pole of the one directed againſt the ſame Pole of the other, or with the South Pole of the one againſt the South Pole of the other, and the Direction of their Polarities magnetically Eaſt and Weſt, they will by Repulſion (as it were in a Duel) reciprocally deſtroy one another in an equal, though long Time: But if they are placed (in the ſame Situation in reſpect of one another, *viz.* North Pole againſt North Pole, or South Pole againſt South Pole) with the Direction of their Polarities in or near to the magnetical Line, that Stone (in North Latitude) whoſe South Pole ſtands directed to, or pretty much towards the attractive Point of the Earth's central Magnet receiving Aſſiſtance therefrom, will not loſe Vertue ſo faſt as the other, and conſequently never loſe all its Vertue till it has perfectly deſtroyed the Polarity of its Antagoniſt, which it will do in leſs Time, and afterward give it ſome Polarity again contrary to what it had at firſt.

XXIV. That Magnetiſm not only in touched Iron and Steel, but alſo in the Loadſtone itſelf, is ſoon deſtroyed by Fire.

XXV. That though Fire deſtroys fixed Magnetiſm in Steel or Iron, yet if they are ſet to cool in an erect Poſture, or rather in the Direction of the magnetical Line, they will gain more or leſs fixed Vertue by the Time they are cold; but eſpecially Steel heated to a ſeaſoning Height, and in that Poſition cooled ſuddenly under Water, which I have found to fix its Polarity ſo throughly, as that with its North Pole held downward, it would attract the North End of a Dial Needle.

XXVI. That while a Piece of Iron of ſome Magnitude is held at one Pole of a Loadſtone, it will increaſe the Attraction of the other Pole thereof, and enable it to lift ſomewhat more.

XXVII. That if either Pole of a Magnet large enough, toucheth one End of an oblong Piece of Steel (not too big and long for the Magnet eaſily to act on) it will tranſmit its own Vertue to the other End of the Steel which is fartheſt off, and make it a Pole of its own Kind, whilſt the End which touches the Stone has Vertue of the contrary Pole: But the Vertue uſually is not ſo ſtrong in the End which is untouched, as in that which is; though I do not know but in ſome Time it may gain more, and the other loſe ſome, until the Vertue in each End is nearly equal.

XXVIII. That any Loadſtone put into a Diſh with its Polarity in an horizontal Situation, and the ſaid Diſh, with the Stone in it, put to ſwim in the Middle of a large Veſſel of Water, will turn itſelf, with the Diſh wherein it is, until its South Pole is directed in the Horizon towards the magnetical North Pole of the

central

central Magnet (by the Force of its Attraction thereof, and Repulſion of the oppoſite Pole) and there reſt after a ſmall Vibration or two.

XXIX. That the Fly of a Compaſs (becauſe it is a perfect Magnet, *Prop.* 12) if it turns eaſy on its Pin, muſt neceſſarily conform its Poles to the magnetical Meridian as the Loadſtone does, and for the ſame Reaſon.

XXX. Alſo becauſe Steel regularly touched is a perfect Magnet, the North Ends of the Flies of ſeveral Compaſſes muſt all of them repel one another, and ſo muſt their South Ends: But the North End of one and the South End of any other, do mutually attract each other, as is ſaid of Loadſtones, *Prop. 4th.* And in North Latitude the North End of a Needle will conſequently vibrate towards the Top of a tranſient Bar erected, and the South End towards the Bottom.

XXXI. That a Needle firſt equally poiſed, then touched and put to oſcillate on its Pivots in the magnetical Meridian, will in North Latitude have its North End (*i. e.* its South Pole) depreſſed until it directs to the North-attracting Point of the central Magnet; where, after ſeveral Oſcillations, it will at laſt reſt: And in South Latitude the South End will be depreſſed after the ſame Manner.

XXXII. That not only a touched horizontal Needle, which has permanent Polarity, will endeavour to conform itſelf to the magnetical Meridian, but alſo one that has no other than tranſient Vertue, and is with the greateſt Care freed from fixed Magnetiſm (if made and uſed as in the *Præcogn.*) will do ſo too, though with this Difference, that which End ſoever happens to be placed neareſt towards the magnetical North will faintly

faintly turn thither; and if that End is not ſuffered to remain ſo too long, then the other End, placed neareſt to the North, will turn thither as the firſt did. In trying this Experiment, I ſometimes found, that when the Needle had reſted in the Meridian only a few Minutes, it gained a perceptible permanent Vertue, ſo that its other End would not be attracted to the magnetical North, unleſs it was placed conſiderably nearer thereto than I had placed the firſt End; and having ſo ſtood ſome Time, loſt again the ſaid inchoate Permanency, and received Polarity, the contrary Way. Once, while I dined, and ſat but a little Time after, I could not make the End which I left towards the South, to ſtand towards the North, unleſs I placed it very true in the Meridian; ſo that I was forced to free it again from Magnetiſm before I could uſe it to repeat the ſame, or try the following Experiment; for the leaſt Fixedneſs of Polarity in the Needle would more or leſs obſtruct both.

At the magnetical Eaſt or Weſt of the Needle's Pin, ſo nice as I could gueſs it, I held at a great Diſtance, either the South Pole of a Loadſtone, or lower End (which is the South Pole) of an erected Bar (both of them anſwered alike) and gradually approached it nearer, in a direct Line, toward the Pin, until it began to attract the Needle, which I obſerved was as I expected at the South End: I then changed the Ends of the Needle, and gradually approached the South Pole of a Magnet as before, and conſtantly found it to attract that End which was toward the South; and the North Pole of the Magnet, after the ſame manner, would attract the North End of the Needle when it had only tranſient Vertue.

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I remember, that in my younger Days I once diverted myſelf with making an horizontal Needle, and a Dial-Box for it, one of my School-fellows having a Load-ſtone. Before I could have the Uſe of the Stone, I often held my Needle within its Box, ſometimes with its intended South End towards the Bottom of a Window Bar (having lately ſeen one of my Companions try it with his Pocket Needle, which was touched) and at other Times I would hold the Needle's North End at the Top of the Bar. I obſerved the Needle, which was hung very tender, to make Vibrations at either End of the Bar. I happened to ſet it down in the Window at a good Diſtance therefrom, and found the South End more inclined to vibrate to the Bar's Bottom than the North End, and ſeeing it to have ſome Vertue, I thought of encreaſing it by taking the Needle out of the Box, and applying it to touch the Bar with its proper Ends. By this Method alone it gained ſuch a Degree of Polarity as would conſtantly turn its proper End to the North, if it was kept trembling; but if I placed its contrary End to the Bar, the Polarity would be changed preſently. By this Way of Management I could give it but a faint Verticity, which was ſoon more vigorous when I got the Uſe of the Stone, though it was ſmall, and not of the beſt, and the Needle ſoft Iron. And this was all, at that Time, I knew of Magnetiſm, having never read the particular Properties of the Stone, nor ſeen one before, nor heard of the untouched Needle's Verticity, or its vibrating to a Bar.

Having within the Space of a few Years paſt had a freſh Inclination to make ſome magnetical Experiments,

riments, amongſt other Thoughts the above-mentioned came into my Mind, That Iron, not having any fixed Polarity at all, might (if it moved tenderly enough) conform its Ends to the magnetical Meridian; which at length put me on making ſuch Needles as are deſcribed in the Beginning, of which either Sort anſwered my Expectations abovementioned. Afterwards I touched one of the firſt Sort of Needles (deſcribed *Præcogn. 7th*, whoſe Length was 2 $\frac{1}{8}$ Inches, and Weight ℈ß and *Gr.* ij) on a Piece of tranſient Iron (made for Armour of a Magnet) which meaſured in Inches each Side of the broad plated Part about 1 $\frac{5}{8}$, the parallelopiped Part in Length 2, and in Breadth (equal to its Thickneſs) $\frac{3}{8}$. So its whole Length was full 3 Inches and $\frac{5}{8}$. Its Weight *Troy* was ℥iiij ℈ij. This held with its Length directed in the magnetical Line, gave the ſaid Needle Vertue enough to vibrate about four times in one Minute. I held the Needle, while touching, in an horizontal Situation, with its North End directed towards the North, and placing its Middle about the Top of the Iron, drew it along Southward: Likewiſe placing its Middle about the Bottom of the ſaid Iron, I drew it Northward, that the South End might be touched as well as the North. I afterwards touched it my new Way (hereafter mentioned) with the ſaid Piece of Armour, and a ſmall Piece of tranſient Iron, which made it vibrate about ſix times, and I believe it would have made more Vibrations, had the Needle been hardened Steel.

Having no other than a ſmall Loadſtone of a very irregular Shape, I was loath to diminiſh it enough to bring it into a tolerable Figure to receive Armour, but did only grind a little Place plain at each Pole,

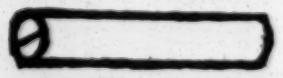
where

where I bound it on with Thread when I had ground it. The Weight thereof naked was but 3vij ℈ij *Gr.* vj; its armed South Pole would only lift 3vij ℈s *Gr.* iij, which was a Key. The not knowing where to get a better, made me think of improving what I had. I conſidered, that ſince a larger Stone of the ſame ſpecifick Vertue would lift more, it might poſſibly communicate more Vertue than mine could to the ſame Piece of Steel, but could not fail of ſo doing to a much greater Piece; and having obſerved that touched Steel would communicate ſome Vertue as well as attract, I got ſome Steel Wire (the largeſt in the Shop where I could meet with any) which having cut into equal Pieces, and filed their Ends ſo tranſverſly as I could, and very plain, I made a Standard with a Plate of Iron, into which I could but juſt thruſt the ſhorteſt; and filing all the reſt till they would but juſt enter the ſaid Standard, I reduced them nicely to the ſame Length. Then having marked one End of each of them with the Edge of a File, I ſeaſoned them very hard, and made them, Ends and all, very bright. Each of them meaſured in Length about 2.74 Inches, and weighed 36 Grains or more. I weighed one of them, and they were all of the ſame Piece of Wire, therefore could not differ much in Weight. With my Loadſtone I touched 37 of them, one by one, making their marked Ends their South Poles. I laid them Side by Side at about half an Inch Diſtance from one another on a Board, with their marked Ends toward the ſame Edge thereof, and took Care that they ſhould not touch one another after they came from the Stone, before they were all of them touched thereon. Then having Thread and Armour made like this  (one Piece marked, which

I applied to the marked Ends of the Wires) in a readineſs, I ſpeedily did thruſt them together into a Bundle, and caſting the Thread 2 or 3 times round them, with my Fingers I formed the Bundle into a regular Hexagon as ſoon as I could, and then bound them faſt from End to End, and bound faſt the Armour. I took the Number 37, becauſe that would form a regular Hexagon at each End, and ſo will alſo 19 or 7. Finding this artificial Magnet exceed my natural one, I held the Artificial in one Hand, and the Natural in the other, the North Pole of the one againſt the South Pole of the other, and placing their Armour on the Middle of one of my Wires, drew the Magnets aſunder, and ſo touched both Ends of the Wire at the ſame Inſtant. In that manner I touched one by one a ſecond Set of Wires, which I managed like the firſt, and bound on the Armour of the firſt Set to the ſecond. The South Pole lifted a Key, Weight *Troy* ℨij ʒij ȝij *Gr.* v. Both Poles united would, with Difficulty, lift the ſaid Key with Weights faſtened to it, the whole ℔j *Troy*. I next tried with 19 Wires, for which I made Armour of a proportionable Size; but that did not anſwer ſo well, I thought, as 37, though I repeated the Touch. Afterward I took 7, which I thought performed according to its Quantity as well as the 37. Therefore I ever after uſed the Number 7.

In the next Place I thought of mending this Way of Touching, by placing all the 7, or more of them, with their marked Ends toward the North in a long ſmall Trench, whoſe Depth was juſt fit for one of them, to keep it from rolling away while I was touching it and its Fellows. The North End of one touching

ing the South End of the other, and adhering by their magnetick Vertue, I placed the two Magnets, as before, at their conjunct Middle (not letting them remain there a Moment) and then inſtantly and ſpeedily drew one Magnet to one End of the Wires, and the other Magnet to the other End of them; by which Method I touched them, as it were, all at once, and as if they had been but one entire long Wire. I found this Way not only more expeditious, but more advantageous, giving all of them a ſtronger Touch: But the Wire at each End was not ſo ſtrongly touched as the reſt; therefore I placed more Wires in the Trench than I had Occaſion for, and laid aſide thoſe at each End, whoſe Vertue was weaker. One of theſe Wires, when it was thus newly touched, would lift a prepared Nail 4.75 Inches long, in Weight *Troy* 3vij *Gr.* vj or vij (*i. e.*) more than 426 Grains. The Weight of the Wire can be had in that of the Nail 11.8$\frac{1}{3}$ times. I placed all the 7 ſeparately in the magnetical Line for about two Days; in which Time all of them had loſt ſome Vertue, yet one of them would with Difficulty lift the Nail aforeſaid, which it lifted ſomewhat eaſier juſt after the Touch; and that which had loſt moſt Vertue, would eaſily lift a Nail of 4$\frac{1}{5}$ Inches long, in Weight 306 Grains.

Having ſuch Succeſs, I got ſeven round Bars of Steel to be made, from End to End of one Size, ſo that they would but juſt go through a Hole made on Purpoſe in a Plate of Iron, and tried their Lengths in a Standard as I did the others, and marked one End of each of them with the Corner of a File in this Manner,  that I might be able to ſee the Mark when they were bound together, leſt either of them ſhould be placed

 with

with its End the wrong Way. Their Diameters were about $\frac{1}{8}$ of an Inch, and their Lengths about 12 $\frac{1}{4}$ Inches good Meaſure. I hardned and cleanſed them as I did the Wires, but one of them happening to break by a Fall in touching, I got it ſupplied, and, for Fear of ſuch another Accident, reduced them to almoſt a blue Colour. I laid them one after another in a Trench planed for them, in a long Piece of Wood about the Depth of half their Diameter, putting their marked Ends all one Way: I made a Hole in the Trench a few Inches from one End of the Piece of Wood, and put a Pin in it to keep the Bars from ſliding to the Ground, and elevated the other End till it was, as I gueſſed, in the magnetical Line. I then touched them with two of my Magnets as before, and this I found the beſt Way of all. When they were finiſhed, and armed with proper Armour, the North Pole lifted above half a Year after ſbj *Troy*, and the South Pole conſiderably more. In making one of theſe, I met with an odd Accident; for after I had begun to touch it, apprehending it was a ſmall Matter bigger than the reſt, I attempted to mend it on a Grinding-ſtone, whoſe Axes were directed about 14 or 15 Degrees from Eaſt towards North, and from Weſt towards South. I was not careful to keep its Poles the proper Way in grinding, but held the Bar ſometimes a-croſs to the Stone, which would make it jar, at other times, with the North Pole toward the North. Afterward I touched it again with the reſt, but could not give it an Attraction equal to that of the others. I happened to try with my Dial-Needle whether the Change of Polarity was in the very Middle of the Bars, or nearer to one End than the other, and in this Bar found ſeveral Polarities contrary to my

Ex-

Expectation, but how many I am not certain, being ſeveral Years ſince, and I not heeding it nicely. As I held it erect, the Bottom was a South Pole, further up no Attraction, the Pole changing a little higher (I think one third Part of the Bar's Length) a ſtrong North Pole, and about ⅔ up a ſtrong South Pole, and at the Top a ſtrong North Pole, the Middle between each Pole not attracting. Whether the jarring on the Grinding-ſtone while held in a wrong Poſture was, as I ſuppoſe, the Cauſe of this irregular Vertue, or whether I might at firſt, by Miſtake, touch it the contrary Way, I durſt not poſitively aſſert; but all my Care and Labour would not help it by touching: For, as the Vertue became ſtronger in the Ends, ſo did alſo the Polarities in the other Parts of the Bar. I was ſomewhat concerned at this Diſappointment, doubting it muſt have been new ſeaſoned, which would have created the Trouble of cleanſing and poliſhing it the ſecond Time. I thought firſt that I would try to cure it by putting it over freſh Wood-Coals in an horizontal Poſture, with its intended South Pole directed towards the magnetical North, which I did, and ſo kept it until it was blue. Then I took it out of the Fire, and cooled it in almoſt the ſame Poſture, for I think the North Pole thereof was elevated. I tried it without retouching, and found it perfectly cured, the Polarity regular throughout, and (which I was ſurprized at) attracted full ſo ſtrongly as either of the reſt.

I next endeavoured to procure Magnetiſm in Steel, without the Aſſiſtance of any Magnet (except the Earth's central one.)

Finding

Finding my artificial Magnets, rightly uſed, would communicate more Vertue to other Steel than they themſelves had, and obſerving that erect Bars had ſome Vertue from the Earth's Magnet, and having alſo experienced that Iron, which had only tranſient Vertue, would, when in an erect Poſture, or in the magnetical Line, give a ſmall Degree of fixed Polarity. (*Vide ſupra, Pag.* 317.)

I ordered nine Steel Bars 0.75 of an Inch ſquare, and 16 Inches long, to be made. Some of them, through the Smith's Fault, were a little leſs; the Weight of the heavieſt was, after it was finiſhed, 3 lb *Avoirdupois*. I made them moderately bright by grinding, and filed their Ends ſo plain as I could, and tranſverſe to their Lengths, by help of a Carpenter's Square; then marked one End of them, and, when hardened, I ſcowred them bright, and poliſhed their Ends very well. I fitted a Piece of Armour for each End of one Bar, and marked the Piece which was for the marked End of the Bar, and bound faſt both Pieces of Armour to the ſame Bar, one at each End: Then ſtanding with my Face toward the Weſt, and holding the Palm of my Left Hand upward, I placed therein one of the Bars without Armour with its marked End Northward, and graſped it faſt at its Middle, with my Fingers on the Weſt Side, and the Ball of my Thumb on the Eaſt Side, where I alſo laid along my whole Thumb to keep it ſteady: So the upper Part of the Bar was open from End to End. Thus holding it, I elevated the South End thereof until I gueſſed it was in the magnetical Line; and holding with my Right Hand the armed Bar, with the Poles of the Armour downward, and the marked End toward the North depreſſed to the

magnetical

magnetical Line, I placed the Pole of the upper Armour about 4 or 5 Inches from the Top of the unarmed Bar, and ſo ſoon as ever it touched the Bar, I began, with the greateſt Speed I could make, to draw it downward until I was paſt the Middle, and from thence to the Bottom gradually ſlower. When it was at the Bottom I permitted it to reſt there about 1 or 2 Seconds. After the ſame Manner applying the Pole of the lower Armour to the unarmed Bar about 4 or 5 Inches from its Bottom, I drew it upward, ſpeedily at firſt, ſlower when above the Middle, letting it reſt a little at the Top. Having upwards and downwards alternately repeated the Touch on the ſame Side of the Bar, I touched the oppoſite Side thereof, which was next my Hand, in the ſame Manner, and afterwards the two other Sides. Then holding the unarmed Bar erect, I uſed to ſee if it had gained any fixed Polarity by holding my ſmall Needle at the Top and at the Bottom of the Bar; for if it had gained any Vertue by the Touch, it would attract the Needle ſtronger, at the ſame Diſtance, when the marked End of the Bar was held downward, than when it was held upward. If I found it had gained any ſenſible Vertue, I took off the Armour from the firſt Bar, and bound it to the ſecond which I had touched, and after the ſame Manner touched the firſt Bar with the ſecond, as I had touched the ſecond with the firſt. And when by Trial with the Compaſs Needle I found the armed Bar had communicated to the other more Vertue than was in itſelf, I took off the Armour and bound it to that which was newly touched, and therewith retouched that which I had diſarmed. In a few Repetitions of changing the Armour from Bar

to

to Bar, and touching the weakeſt, I procured in both of them (without the Aſſiſtance of either of the other ſeven) a fixed Polarity to ſuch a Degree as that the North Pole, or unmarked End of either of them held downward, would attract the North End of the Needle, though much fainter than if the North Pole of the Bar had been upward, and Poſition did not now change their Polarities, but only weaken them: Therefore I now call their Vertue perfectly permanent. Four or five Repetitions more encreaſed their Vertue to ſuch a Degree as that the South Pole of one of them would lift a Ten-penny Nail prepared, and after 2 or 3 Repetitions more a common Door Key of an Iron Box-Lock, Weight *Troy* ℥j and above ℈ij, not by the Bow, but by its lower End, which was wrought ſomewhat globular and poliſhed. In the laſt Place I got a Piece of Inch Deal above three Inches broad and 7 or 8 Feet long, in the Middle whereof, at about 5 or 6 Inches from one End, I made a Hole through with a large Gimlet, into which I drove an Iron or Steel Pin, whoſe Length (beſides what went into the Wood) was a little leſs than the Thickneſs of one of the Bars. Then I placed the biggeſt Bar on the ſaid Board with its marked End cloſe to the Pin, and its Length parallel to that of the Board, and with an Awl made four ſmall Holes in the Board, one of them on each Side of the Bar about an Inch from the Bottom, and about the Thickneſs of a Sixpence, from its Sides, and the other two after the ſame Manner, about an Inch from the Top. I drove into them Pins of large Wire half an Inch long, beſides what was in the Board. The Pins were to keep the Bars from ſliding out of their Places in touching. Then removing that, and placing

any other Bar between the ſaid Pins, with its marked End cloſe againſt the great Pin, I placed the marked End of the ſaid biggeſt Bar cloſe againſt the unmarked End of the other, and made four Holes on its Sides, and drove Pins in them as before, and ſo continued to do, until the Board was full: It held half a Dozen Bars. I took Care to place the marked End of every Bar directed towards the great Iron Pin which was to keep them from ſliding down to the Ground, when the other End of the Board was elevated, to ſtand in the magnetical Line. The Board ſtanding with one End on the Ground, and the other leaning againſt the Wall, at the South End of the Room, I took the armed Bar, which had Vertue, and placed its North Pole's Armour about the Middle of the higheſt Bar, whoſe Middle I could reach to (keeping the Armour of the South Pole a little upon one Side of the Bars, juſt ſo far as I might be ſure not to touch them with that End) and then immediately drew it from thence downward to the Bottom of the loweſt Bar: After the ſame Manner placing the Armour of the South Pole on the Middle of the loweſt Bar (and holding the armed North Pole on one Side, that it might not touch) I drew it upward to the Top of the higheſt Bar, whoſe Top I could reach. And if the End of any Bar was a little under that which it reſted againſt, I uſed to put a ſizeable Chip under it, that the Armour might not hitch in drawing it over the Places of their Contacts. I uſually touched the Bars on all four of their Sides, then took out the loweſt, and (letting the reſt gently ſlide down to the Iron Pin) placed it at the Top, that thoſe which were firſt at the Top might in their Turns take their Places in the Middle, and be well touched.

I commonly reſted at the End of each Bar in drawing (as in the ſingle Bar before mentioned, *Pag.* 325.) When I found thoſe on the Board conſiderably ſtronger than my armed one, I took out that which I thought attracted beſt, and bound the Armour to it, putting the other in its Room. After ſeveral repeated Touchings, the biggeſt of them being ℔iij *Avoirdupois*,



would be ſuſpended by its North Pole to the South Pole of one of the beſt of the others. They did not lift one another, or attract ſo well when their Ends were applied centrally, as when applied to one another (as is expreſſed in the Figure) near to their oppoſite Corners. The Line *m* in the End of each Bar repreſents the Manner I uſed to mark their intended South Poles. With one of theſe armed, I touched a ſmall ſquare Bar of Steel (placed betwixt two of the great ones) the Length whereof was 2.156 Inches, the Breadth of each Side 0.27 (or ſomewhat more than ¼ of an Inch) the Weight ʒv *Gr.* iv (*i. e.* 304 Grains) it would lift afterwards an Iron 5¼ Inches long, weighing ʒiv ʒj ʒj or, 2000 *Gr.* 304 can be had 6.578 times in 2000. So it lifted above 6½ times its own Weight. With this little Bar naked I touched a ſmall Dial-Needle made of Steel (the Socket in the Middle was alſo Steel, and not Braſs, as uſual) I ſeaſoned it very hard, and cleanſed it well, and with much Care, not to break it, becauſe ſo hard. It weighs not full 4 Grains, has lifted two prepared Six-penny Nails, one at each End, while it was held in an horizontal Poſture with its South Pole towards the North. It alſo lifted a Key by the Bow, as it was held perpendicularly

dicularly with its South Pole downward, the Weight whereof was 3j ϑij *Gr.* xv good Weight (*i. e.* 115 Grains or better) Wherefore ſince the Needle weighed leſs than 4 Gr. which is the 29th Part of 116, we may reckon it lifted full 29 times its own Weight by the Force of one Pole, the Key having no permanent Vertue before.

I never ſaw this Communication of Magnetiſm outdone by the Loadſtone itſelf, as it is commonly uſed; but what a good one would do, uſed as I did the Steel, I know not for want thereof, but doubt, unleſs Steel could be made better than it uſually is, a ſtronger Degree of Attraction therein is ſcarce to be hoped for from the Uſe of the beſt of Loadſtones.

I uſually find the attractive Power in ſquare Bars cut plain over tranſverſe to their Lengths, to be ſtrongeſt, not in the Middle of their Ends, but much nearer to their Corners or Sides, and to be greater at one Corner or Side than another; and this not only in ſuch as are of touched Steel, but in Iron ones having no Polarity, but from their Poſition. The ſame I obſerved in round Bars, if their Ends are not convex.

In ſome of my large Steel Bars (as alſo in ſome of the round Bars) I found the North Pole ſtrongeſt, in others the South. I know not the Cauſe thereof; for though I touched the weaker End twice ſo often as the ſtronger, it would ſtill continue to be ſo, when the ſtrongeſt had been well touched before. I imagine it muſt be owing to ſome Inequality of the Steel occaſioned by the different Degree of Heat taken at the Forging; different Degree of Heat when the Smith deſiſted hammering; different Degree of Heat in making the Iron into Steel, or Quantity of what is uſed in doing it; Fineneſs of

the Iron whereof the Steel was made, ſome ſmall Difference in Magnitude, or Difference in ſeaſoning, it being almoſt impoſſible to make both Ends equally hard; but that both Ends of mine might be ſo, I had a Fire made long enough to heat their whole Length at one and the ſame Time.

I left ſeveral of the Bars on the Board whereon they were touched, and in the ſame Poſition to one another, as well as to the Earth, for ſome Months, to ſee whether they would loſe any of their Vertue; but if they did, it was ſo little as I could not be ſure thereof.

I alſo tried whether what I mentioned concerning Loadſtones (*beginning at Page* 303) would hold in 5 or 6 Barsr egularly touched and placed to one another in the ſame Manner; and found that at ſome of the Joinings it anſwered pretty well, but not ſo well at others, uſually beſt at the two extream Joints, and worſe at the middle ones. When I held the Dial-Needle at a good Diſtance from the Bars (perhaps 6 or 8 Inches) the Attraction was more regular, and the different Poles of the two Bars at their Contact was not ſo eaſily diſcernable; but when I held it within 2 or 3 Inches Diſtance, both of the Poles diſcovered themſelves more or leſs at every Joint. Perhaps the Cauſe may be the Want of a better Contact, the Ends of the Bars not being true Plains; or it may be partly owing to their conjunct Length (though I cannot ſee how that ſhould cauſe it) or ſome Irregularity in the Vertue of each particular Bar. For it has been obſerved, that very oblong Iron, as Wire, is capable of having a North Pole in both Ends, and a South one in its Middle; or, as my round Bar beforementi-

mentioned, ſeveral Polarities in no greater Length than about one Foot. My Bars were not made of *German*, but more ordinary Steel, of about 4 *d. per* ℔.

I never yet tried the Experiment of weighing Pieces of oblong Steel juſt before, and preſently after the Touch, but ſuppoſe (from Mr. *Norman*'s Experiment, *New Attractive*, *Chap.* vi.) that my own Conjectures are right, *viz.* That oblong Steel of a convenient Length and Weight, perhaps 3 or 4 Feet, and 10 or 11 Ounces, may, if weighed with a very nice Beam, made of Iron or. Steel, the Cords of the Scales being of a common Length, ſeem to loſe a Grain or two of its Weight (more or leſs according to the Subſtance of the Beam, Shortneſs of the Cords, and Degree of Magnetiſm in the touched Steel). I ſay, ſeem to loſe, becauſe the touched Steel with one of its Poles attracts the Beam not juſt at the End thereof to which it is ſuſpended; but there, and, more or leſs, all the Way between the ſaid Point of Suſpenſion and the Middle of the Beam. This muſt make it apparently (not really) to ponderate leſs, as is the Caſe of Stilliards, demonſtrated by the Doctrine of the Leaver: Alſo the other half of the Beam being ſomewhat attracted by the other Pole of the Steel, aſſiſts the Weights which are laid againſt the Steel, and encreaſeth the Miſtake, which is greater or leſs, according to the Poſture of the Steel, whether (if horizontal) it is parallel or perpendicular to the Beam, or (if in an erect Poſture) according to which Pole is upward. My Thoughts are, that Steel after the Touch (Allowance being made for what is rubbed off by touching, which I take to be inſenſible, if done on ſoft Armour) muſt, if in an horizontal Poſture, neceſſarily

draw

draw ſomewhat more Weight than before; or if in an erect Poſture in North Latitude with the South Pole downward more, and upwards leſs than in an horizontal Poſture: But theſe Differences are ſo ſmall as no Experiment I can think on will render ſenſible in the leaſt Degree, becauſe of the vaſt Diſtance between the Surface of the Earth and the attractive Point of the internal Magnet: For ſince Attraction and Repulſion are at the ſame Diſtance equal, I ſay the one Pole of a Bar of Steel 10 or 20 Feet long, directed toward the attractive Point of the Magnet, ſuppoſed at the Diſtance of but one or two Miles, is not ſenſibly nearer to it than the other (I mean in reſpect to Attraction) how much more inſenſible then muſt the far greater Diſtance of 2000 Miles render it, which is not ſo remote as Mr. *Whiſton* (Longitude and Latitude found by the Dipping-Needle, *Pag.* 48. *Line* 12) ſuppoſes it to be. I cannot think fit to call the Point to which the Needle tends a reſpective Point, as Mr. *Norman* does, ſince his Experiments, *Chap.* VI. do not convince me (by reaſon of the Diſtance thereof from the Surface of the Earth) that it is not an attractive one. If therefore Steel after the Touch is ever found to weigh (with a Beam of Matter not magnetical, and in a Place at too great Diſtance from any Iron or Magnet to be ſenſibly affected thereby) either more or leſs than before, it muſt be occaſioned by the Augmentation or Diminution of its Quantity of Matter by the Touch. The former ſeems impoſſible, becauſe a Magnet loſes no ſenſible Weight by having 10000 Pieces of Steel ſucceſſively touched on its Armour; nor is the latter probable, unleſs the Weight of the Magnet is encreaſed, or Part of the Subſtance

of

of the Steel ground off by touching: And if the Quantity of Steel is, by rubbing, diminiſhed, the Lightneſs is not owing to its having Magnetiſm, but to its Defect of Matter. Before an Experiment of this Nature is made, the Piece of Steel ſhould be well hardned, poliſhed, and wiped very clean, and if warm by rubbing or handling, ſhould be permitted to cool before it is weighed. Then being weighed with a Braſs Beam, let it afterward be well touched on the ſoft Armour of a Magnet, then wiped clean, and permitted to cool, before it is weighed after the Touch. Care muſt alſo be taken that no Iron Bar, or other Magnet, be in the Window, or any other Part of the Room above, or that underneath, large enough to affect it, which a Magnet, the Brads of the Floor, or other Iron in the ſame Room, or about the Operator, ſuch as a Key, Knife, Buckles, or the like, may more or leſs do, according to their Diſtance and Situation: And I have ſeen a Brad in the Floor make the End of a large horizontal Needle dip to it at the Diſtance of above an Inch.

Mr. *Whiſton* in his ſaid Book, *Pag.* 47, ſuppoſes the Surface of the Earth's central Magnet to be diſtant in Miles from the Surface of the Earth 3400, and accordingly, *Pag.* 48, computes the Semidiameter of the ſaid Magnet to be about 575; both which Sums added, make the Semidiameter of the Earth to be about 3975 Miles; which is about 7 Miles leſs than Mr *Norwood* makes it by reckoning 69½ Miles to a Degree, which multiplied by 360, makes 25020 in the whole Circumference, and the Radius (by *Van Ceulen*'s Proportion of the Circumference to the Diameter) I find to be 3982.0566, *&c.* which 7 Miles is but a Trifle in 3975, or 3982.

I ſhall

I ſhall then ſuppoſe the Earth's Radius (in Miles) 3975, from whence I compute the Circumference 24975.6615,9603,8855, &c. And one Degree 69.3768,3776,6774,5988,3, &c.

Mr. *Whiſton*, *Pag.* 53, ſays that the Northern magnetick Pole was then about 13½ Degrees from the North Pole of the Earth: The Sine of which in natural Numbers is 233,4454 to the Radius 1000,0000.

1. As the Earth's Radius (in Miles) 3975, to the above-mentioned Sine of 13 Deg. 30 Min. 233,4454. So the ſaid Magnet's Radius 575 Miles to the Tabular Number 33.7688,3144,6540,8805,0311, &c.

2. As the Tabular Radius 1000,0000, to the ſaid Tabular Number, ſo (in Miles) is the Earth's Radius to the Radius of the Parallel of 13½ *Gr.* on the ſaid Magnet's Surface: Or, ſo is the Earth's whole Circumference to the Circumference of the Central Magnet's ſaid Parallel: Or, ſo is one Degree of the Earth's great Circle in Miles to one Degree of the ſaid Parallel of 13½ *Gr.* on the ſaid Magnet's Surface 2.3427,7474,0840,2028,43, &c.

The ſaid Degree reduced into Feet, and into Inches, is,

In Feet and Parts 12369,8506,3163,6271,0156,59, &c.

In Inches and Parts 148438.2075,7963,5252,1879,14, &c.

Which 2.3427, &c. Miles the North magnetick Pole of the central Loadſtone moves in ſomewhat leſs Time than 4 ſolar Minutes, *viz.* in about 4 Minutes by the diurnal apparent Motion of the fixed Stars) But for as much as the *Ratio* of the internal Magnet's Diameter to that of the Earth, is not probably calculated to Perfection, I ſhall proceed as if the ſaid Pole of the Magnet moved the ſaid Space perfectly in the Time of four Stellar Minutes.

For

For want of a more convenient Inſtrument, I took a Whirligig of Wood, ſomewhat more than $\frac{1}{4}$ of an Inch thick, and in Diameter at leaſt 1.8 Inch. It was turned truly round, and had in its Diameter nigh to, and equidiſtant from the Centre two Holes made, into which, as uſual, was a Thread put, of about 40 Inches long, and about 20 when it was put in, and the two Ends tied together. I went with it to a Clock, whoſe Pendulum oſcillated Seconds, and working the Whirligig ſtrong enough to make its Returns, or Vibrations, keep equal Times with the Pendulum's Oſcillations, I ſuddenly caught the Whirligig at the End of one Vibration before it began another, and then (untwiſting the double Thread gradually with my Fingers) I told how many Turns or Revolves it had made in that one Vibration, and found the Thread untwiſted with 58 Turns (which is but half the Number in one Vibration, becauſe in the whole Vibration it was twiſted the like Number of Turns the other Way) which doubled makes 116 Turns in each Vibration, and in one Second of Time. I computed the mean Velocity of the Circumference thereof in each Second of Time to be about 54 Feet 7 Inches 9645,4606, *&c.* Parts. By this it is plain, that a Globe (as well as a Wheel) of 6 Inches in Circumference, if truly centered, is eaſily capable of being kept in Motion on its Poles, ſo ſwift that its Æquator ſhall have the Velocity of 51 Feet 5410,4429,8, *&c.* Parts, by making 103.0820.8859, *&c.* Turns in one Second. This is the proper Velocity for ſuch an Experiment, becauſe it is nearly equal to that of the North magnetick Pole of the internal Loadſtone along the Parallel of $13\frac{1}{2}$ Degrees from the Poles of its Rotation.

The Velocity of the ſaid magnetical Pole of the internal Loadſtone is, as above, in the Time of 4 Minutes, in Inches and Decimal Parts 148438.2075,7963, 5252,1879,14.

And therefore in the Time of one Minute 37109. 5518,9490,8813,0469,786, and in one Second 618.4925,3158,1813, 5507,8297, which 618.4925, *&c.* Inches reduced to Feet and Decimal Parts, is 51.5410,4429,8; *&c.*

Suppoſe then a Terrella was made of juſt 6 Inches in Circumference. N *z* S *n* (*Vid. Fig.* 1. *Pl.*) contrived to gyrate on Poles *z n* choſen in any two oppoſite Points of its magnetical Æquator, and the Axis of its Rotation *z n* ſituated (as near as Art can do it) in the magnetical Line; for in this Poſture of the Axis the magnetical Poles of the Terrella will be equally wrought on by the Earth's attractive Point all the Way as it is turned round, which can be in no other Poſture whatſoever: For if the Axis of its Rotation makes the leaſt Angle with the magnetical Line, as the Terrella is turned round, the magnetick Poles of it will be attracted and repelled more when on one Side than when on the other, which ought not to be, becauſe it is probable it may have the ſame Effect which a large Magnet would have, if held within the Attraction, and conſequently change the Polarity, as by a Touch, and not purely by the Gyration thereof.

The Circle N *z* S *n* repreſents the Terrella in Circumference juſt 6 Inches (having both, or at leaſt one, of its attractive Poles nicely marked) cemented, or bound with Thread faſt to a cylindrical Veſſel of Wood, or Braſs pretty thin, that it may not be too heavy, with its Polarity N S tranſverſe to the Axis of the

ſaid

ſaid cylindrical Veſſel, whoſe Diameter on the Inſide ought to be equal to that of the Terrella, and its Depth not leſs than the Radius. Or, if the Terrella is truly globular, inſtead of the cylindrical there may be a concave Veſſel (repreſented by the pricked Line *x n w*) leſs than a Hemiſphere, and its Diameter of Concavity ſomewhat leſs than that of the Terrella; ſo ſhall their Contact be wholly at the Brim of the Veſſel, which will keep the Terrella central. And this may be better than a Cylinder, becauſe lighter, and the moſt of its Parts nearer to the Axis of its Verticity. Either of theſe is to be centrally fixed to the Arbor *n m*, which, together with its Pivot *r*, ſhould be made of Braſs, and the Pivot Work in a Hole made fit for it in a Horſe's Tooth, or ſome ſuch Thing: The End of the Pivot ſhould reſt on the Bottom of the Hole, that it may move the eaſier. The Collar at P, in which the Arbor turns round, may be made of Tooth alſo, and both that and the Pivot aforeſaid ſhould be kept well oiled, or greaſed, to prevent their being heated by ſo rapid a Motion as is neceſſary, and ſo ſhould alſo the other Axles. This is to be kept in Motion by a Gut-ſtring (as the Spill of a Spinning-Turn is moved) tied pretty ſtrait round the little Wheel at *m*, and the greater one at F, which String is repreſented by the pricked Line. And the Wheel F is turned after the ſame Manner, by a larger Gut-ſtring round the Wheels *t* and Q, which muſt be ſtrained very ſtraight, that it may not ſlide on the Wheels. To prevent which Inconvenience, this String (and the other, if need be) may be rubbed well with powdered Roſin. I think a Gut-ſtring round a great Wheel and leſſer one, will work eaſier than the beſt of Clock-work, and without rattling

or jarring, which the latter, when in a rapid Motion, is ſubject to, and therefore I cannot approve of it, nor is the multiplying Power of the Wheels *m* F, being 10.3082, *&c.* ſo nearly to be calculated for a Wheel and Pinion; but, if good Work, it may be allowed in the Wheels *t* Q, which move ſlower: But that I apprehend will needleſly encreaſe the Charge. The Diameter of each Wheel at the Bottom of the Trench, where the String touches it, is mentioned in the Draught. The whole may be made to turn with one's Hand, either with a Crank Q *g* in the Arbour of the Wheel Q, or with a Turner like that of a Grinding-ſtone R.

Mr. *W———n*, *Page* 78, makes one Revolution of the central Magnet, in reſpect of the Earth, to be not leſs than 1920 Years, which I have reduced to 701280 Days, to which I add 1920 Days, which makes the Sum 703200, being the Number of Revolutions, nearly, which the Earth and the ſaid Magnet with it, makes in 1920 Years in reſpect of the fixed Stars. Now ſince the magnetick Pole of a Terrella 6 Inches in Circumference, centered as above is directed, and moving with the Velocity of 51 Feet 5410,4429, *&c.* Parts in the Time of one Second, by making 103.9820,8859, *&c.* Turns, moves equally rapid with that of the central Magnet, it may be expected that 703200 of its Revolutions ſhould gradually tranſlate each of its Poles one entire Circle, which 703200 Revolutions (at 103.0820, *&c. per* Second) will be finiſhed in the Time of 6821 Seconds 7476,9272,396 parts, or $1^{h}\ 53'\ 41''\ 44'''\ 51''''\ 41'''''$. Or,

351600 Revolut. tranſlate it $\frac{1}{2}$ a Circle in 3410.8738, 4636,198″, or 0. 56′ 50″ 52‴ 25⁗ 50⁗⁗.

175800

175808 Revolut. tranſlate it $\frac{1}{4}$ of a Circle in 1705.4319, 2318,099″, or 0.28′ 25″ 26‴ 12⁗ 55⁗‘.

117200 Revolut. tranſlate it $\frac{1}{6}$ of a Circle in 1136.9579, 4878,732″, or 0.18′ 56″ 57‴ 28⁗ 36⁗‘.

If the Terrella's Circumference is more than *6* Inches, the magnetical Poles thereof may be placed ſo oblique to the Axis of the Cylinder, as that in turning round they may each of them deſcribe a leſſer Circle (or as it may be called a Parallel of Latitude) juſt *6* Inches in Circumference, and that will cauſe no Alteration in the Swiftneſs of the Motion of the Machine, which is to be moved as follows, *viz.* The Perſon that works it muſt keep his Eye on a Pendulum oſcillating Seconds, and turn the Crank (or Turner) once round at each Oſcillation, ſo ſhall the Number of the Terrella's Revolutions, and Celerity of the Motion of its Poles be as is above-mentioned.

But if the Terrella is larger than 6 Inches in Circumference, and its Polarity tranſverſe to the Axis of its Rotation, the Pendulum may be lengthened in Proportion of the Squares of their Circumferences, and the Crank muſt then make one Turn at each Oſcillation of the Pendulum ſo lengthened; and by that Means it will move with the ſame Celerity which was above propoſed; but then the 703200 Revolutions will not be finiſhed in leſs Time than 6821 Seconds (or rather Oſcillations) made by the lengthened Pendulum.

If by the keeping a Terrella in Motion in ſuch a Poſture, and with ſuch Celerity as is aforeſaid, the magnetical Poles thereof, in reſpect of the Terrella, remain immoveable, I think this is a plain Demonſtration that the central Magnet is looſe from the

Earth,

Earth, and revolves within it a little ſlower, as is conjectured by ſeveral, and to me ſeems moſt probable.

But if the magnetical Poles, by ſuch a Motion as is deſcribed, ſhould in reſpect of the Terrella be tranſlated with a Motion retrograde to that wherein it was kept by the Machine, I ſhould think it poſſible for the diurnal Motion of the central Magnet to tranſlate the Polarity thereof farther Weſtward by the Vertue of its own Effluvia, which are continually left a little behind, as it revolves on its Axle Eaſtward, and that the ſaid Magnet is fixed to the Earth. But theſe Things ſeem uncertain.

However, I think it not impoſſible to reduce the Period of the Motion of the magnetical Pole, in reſpect of the Earth, to a tolerable Calculation in much leſs Time than an entire Revolution thereof, by meaſuring daily the Quantity thereof: For effecting which, I have thought on a new Way of making a Needle not above 6 Feet long, with ſome Engine-work to its Box, which, I believe, I can demonſtrate will render it viſible daily to a naked Eye, that the Variation is changed: But I have no Time at preſent to deſcribe it, being but juſt able to finiſh this; but if it may be acceptable, ſhall readily communicate it on Notice.

II. *An*

II. *An Eſſay upon the Uſe of the* Bile *in the Animal Oeconomy, founded on an Obſervation of a Wound in the* Gall-Bladder. *By* Alexander Stuart, *M. D. Phyſician to her Majeſty, and F. R. S.*

The CASE *of Mr.* Menzies, *Sergeant in the Second Troop of Horſe-Grenadier Guards, wounded in the Gall-Bladder, with the Appearances in the Body after Death, and the Symptoms during Life; with ſome practical Inferences drawn from it.*

HE was wounded about Three o'Clock in the Morning, the 30th of *October*, 1728, and died the 5th of *November* following in the Morning, being the ſeventh Day after he was wounded, in the fortieth Year of his Age.

Appearances in the Body, opened by Mr. *Coldham*, Surgeon, in the Preſence of Meſſieurs *Fiquel* and *Black*, Surgeons, with ſeveral Gentlemen, and myſelf.

I. The *Abdomen* appeared diſtended as in a Tympany, or Aſcites, and the Skin of the Belly tinged yellow as Saffron in many Places.

II. A triangular Wound appeared about two Inches on the right Side of the Navel, the Direction ſlanting upwards obliquely through the Integuments.

III. The Belly being opened, diſcovered the Wound to have penetrated through the *Peritonæum*, and the Sword had ſlanted upwards from thence along the *Omentum*, grazing ſlightly upon it, which was ſuperficially ruffled, but ſo as to be hardly perceivable.

IV. A

IV. A ſmall triangular Wound appeared in the Bottom of the *Gall-Bladder*, which had penetrated through the Membranes into its Cavity, but had no where wounded the Liver, nor any of the neighbouring Parts.

V. The *Gall-Bladder* was flaccid or collapſed, containing only a few Drops of Gall, which, by preſſing the *Cyſtis* ſlightly, flowed out into the Cavity of the *Abdomen* through the Wound.

VI. The *Guts* throughout their whole Tract being diſtended, ſo as could be judged to triple the Extent of their natural Diameters, ſeemed to fill the whole Cavity of the *Abdomen*, ſo as to give the outward Appearance of a Tympany, or Aſcites; which Diſtenſion diſappeared, and the *Guts* collapſed, upon making ſeveral Punctures with a Lancet in their Sides, to give Vent to the Air.

VII. The reſt of the Cavity of the *Abdomen*, which was not cloſely filled up by the diſtended Guts, contained a groſs muddy Water, or Serum, intenſely yellow, or highly tinged with Gall, to the Quantity of three Quarts, as I was able to gueſs without meaſuring it.

VIII. All the *Guts* and Contents of the *Abdomen* were highly tinged with this yellow Liquor, but no other Part of his Body, out of the Contact of this Liquor, had the leaſt Appearance of it.

IX. No Inflammation appeared in any Part of the *Guts*, or in any of the *Viſcera*, or Contents of the *Abdomen*, which were all ſound and healthy.

X. The Obliquity of the Wound through the *Integuments*, *Muſcles* and *Peritonæum*, made it impoſ-

ſible

ſible for the external Air to enter into the Cavity of the *Abdomen* that Way.

The Symptoms during Life.

I was called the 2d Day of *November* about Eleven o'Clock in the Forenoon, being the fourth Day after he received the Wound.

I. The Surgeons who had attended him from the Beginning, Meſſieurs *Fiquel*, *Coldham*, *Wilkie* and *Black*, being preſent, told me that his Belly had been diſtended, as I ſaw it, from the Beginning, giving the Appearance of a Tympany, or Aſcites, and it continued at the ſame Pitch of Diſtenſion, neither diminiſhed, nor ſenſibly encreaſed, to the Time of his Death.

II. No *Ructus* or *Flatus*, upwards or downwards, nor *Borborygmi*, notwithſtanding this Diſtenſion of the Belly.

III. He never went once to Stool after he received the Wound, though pretty ſtrong Purgatives and ſeveral Clyſters had been given for the three Days before I came; and though no Opiat (which might have been ſuppoſed to have retarded their Operation) had hitherto been exhibited: Neither had thoſe Purgatives nor Clyſters, which I ordered afterwards, the leaſt Effect.

IV. He took what was thought a ſufficient Quantity of Drink and liquid Food.

V. He never ſlept, or but very little, by ſhort Slumbers, of about half an Hour, or an Hour at longeſt, and that very rarely, notwithſtanding pretty large Doſes of Opiats were given to procure Reſt, after I came.

VI. The Wound in the *Integuments* never digeſted in the uſual Manner; but looked flaccid, or flabby and pale, almoſt without Pus.

VII. The *Urine* in very ſmall Quantity, at moſt two or three Spoonfuls at a time, clear but yellow, as if tinged ſlightly with Saffron, and without Sediment.

VIII. His *Pulſe* was full, ſtrong and even, but not quick.

IX. No feveriſh Heat to be felt in the *Skin*, on any Part of the Body.

X. His *Tongue* not hard, rough or black, as in a Fever, but of its natural Colour, with a ſilky Drineſs, and very little *Saliva*.

XI. He was not in the leaſt delirious, from the Beginning to the Time of his Death.

XII. He had ſome ſlight Fits of the Hickup the ſecond Day after I ſaw him, and ſome few Reachings to vomit; ſome Intermiſſions in his *Pulſe*, ſometimes one in 10, 15, 20, or 30 a Day before his Death.

In order to make ſome Uſe of this Caſe, it is neceſſary to premiſe, that as Reaſoning without a Foundation in Facts and Experiments, does rarely lead to any Certainty in Natural Knowledge, ſo Obſervations of Facts and Experiments themſelves, would be, in a great Meaſure, fruitleſs, if we did not endeavour, by Reaſoning, to draw obvious, uſeful and practical Concluſions from them: In order to which, it muſt be obſerved, That the great *Apparatus* in the *Liver* and *Spleen*, two of the largeſt *Viſcera* in the Body, confeſſedly deſigned for the Preparation and Secretion of the *Bile*; and the Place of the *Inteſtines*, into which it is immediately depoſited, afford indeed a ſtrong Argument

gument for the univerſal Uſe of it in the Animal Œconomy; but do not directly point out what, or how many theſe Uſes are, about which there has been a great Variety of Opinions.

But this ſingular Caſe, which muſt have happened very rarely, if ever before (wherein none of the Inwards, or *Viſcera*, but the *Gall-Bladder* only was wounded, and by that Wound nothing but the *Gall* was loſt or miſplaced) by ſhewing how many Functions in the Animal Œconomy were impaired or deſtroyed by the ſole Loſs or Want of it, does at the ſame Time point out or demonſtrate the Uſe and Neceſſity of it towards Health, or the Perfection of theſe Functions; and perhaps may lead to ſome Indications of Cure, in Caſes wherein it is known to be deficient, faulty or redundant.

There was no other apparent or aſſignable Cauſe for theſe various Symptoms during his Life, of Death itſelf, and of thoſe ſeveral Appearances in the Body diſſected after Death, but this Wound in the *Gall-Bladder:* And as this Wound could not affect any of the Parts, nor produce theſe Symptoms in any other Senſe than as it gave Vent to the *Gall* into the Cavity of the *Abdomen*, and deprived the Cavity of the *Inteſtines* and the *Blood* of it: Therefore from this Loſs and Miſplacing of the *Gall*, all theſe Symptoms and Appearances may juſtly be concluded to ariſe, and I think may be accounted for from that Cauſe in the following Manner.

I. The *Abdomen* was diſtended, as in a Tympany, or Acites, from the Beginning, and the *Guts* appeared inflated to their utmoſt Diameters.

It is true, that this Inflation and Diſtenſion happens to moſt a few Hours before Death, and to all ſoon

after Death, and ariſeth from the Spring, or Elater of the Air included, getting the better of its Antagoniſt Spring, or Elater of the muſcular Fibres of the *Stomach* and *Guts*, which have no longer the Aſſiſtance of the *Blood* and *Spirits* to contract them, and keep up their periſtaltic Motion. But the Inflation and Diſtenſion here ſpoken of, was ſeveral Days before Death, and, as I have been told, the very next Day after he received the Wound, though the *Pulſe* was apparently ſtrong and equal, and therefore a Defect of *Blood* and *Spirits* not to be ſuſpected: And therefore it may be juſtly concluded, that the Influx of the *Gall* into the Cavity of the *Guts*, is as neceſſary to the Strength of their Contraction and Perfection of their periſtaltic Motion, as that of the *Blood* and *Spirits* into their *Sides*; and that theſe three are the conjunct Cauſes of this Motion in Health, which would be defective by the total Want of any of them.

Hence we ſee that in Scyrrhoſities of the *Liver*, where the Secretion, and therefore the Excretion of the *Bile* is more or leſs defective; and in the *Jaundice*, where, by ſome Obſtruction in the *Biliary Ducts* after Secretion, a Part of it is forced back, and regurgitates into the *Blood*, and very little of it is thrown into the *Guts*: I ſay, in thoſe Caſes we obſerve an uncommon Diſtenſion in the *Guts*, and Coſtiveneſs; which, if the Caſe proves incurable, terminates in an Acites, or Dropſy, in the Cavity of the Belly.

It may alſo be worth while to enquire, whether that which is commonly called an Hyſteric, or nervous Cholic, generally attended with a leſſer Degree of ſuch like Diſtenſions, with *Flatus's* and *Borborygmi*; I ſay, whether this Diſtemper, wherein the animal

mal Spirits are ſo much, and only accuſed, does not partly ariſe from a ſluggiſh Secretion and Excretion of the *Bile*, occaſioning a Defect in its Quantity; or from its Acrimony and great Viſcoſity, occaſioned by its Stagnation in the *Gall-Bladder*; or from both theſe, as well as from a defective or unequal Diſtribution of the *Blood* and *Spirits* in the Parts affected. In confirmation of which, I have generally obſerved, that at ſome time or other in the Cure, a great Evacuation of porraceous viſcid *Bile*, brought away either by Art or Nature, as well as a great Profuſion of pale *Urine*, finiſhed the Cure for that Time. The Vomiting of porraceous *Bile*, very common in ſuch Caſes, proves the ſame; and, I believe, it is generally allowed, that the ferruginous, porraceous and black Colour of the *Bile*, are owing to ſhorter or longer Stagnations of it, chiefly in the *Gall-Bladder*, which the ſedentary Life of thoſe who are ſubject to theſe Cholics, will ſufficiently account for, even if there was no other Error in their Way of living; and whoever has obſerved the high yellow Colour and Contents of the *Urine* in a *Jaundice*, ariſing from a Redundancy of *Bile* in the *Blood*, will readily acknowledge that an uncommon watery Paleneſs in the *Urine*, where no more than the uſual Quantity of Fluids has been taken down to dilute it, doesſhew a Defect of *Bile* in the *Blood*; and I believe it is eaſy to account for the *Flatus's*, *Borborygmi*, Inverſions of the periſtaltic Motion, the *Pila Hyſterica*, *Palpitations*, *Scotomia*, *Vertigo*, and other Symptoms of theſe Diſtempers, which are called Nervous and Hyſteric, from the ſame Cauſe. And hence it is, that Bitters and Steel, known *Deobſtruents* of the *Liver*, and *Correctors* of the *Bile*, with gentle Chologogues

in

in very ſmall Doſes, are of ſo much Uſe in ſuch Caſes; though it be certainly true, that all ſtrong ſtimulating Purgatives are very hurtful and improper.

II. But to return to our Caſe, there was no *Ructus's* or *Flatus's* upwards or downwards, nor *Borborygmi*, notwithſtanding this Diſtenſion of the *Belly* and Inflation of the *Guts*.

This, I think, ſhews very plainly that the *Guts* had loſt all Motion, and were Paralytic by a total Want of *Bile* only, as much as if their Nerves had been totally obſtructed: For had any Motion remained in them, whether the natural and regular periſtaltic Motion, or a preternatural convulſive one, the Contraction of them either Way, would have propelled the contained Air from one Place to another, and would have occaſioned *Borborygmi*, or would have expelled a Part of it upwards or downwards, when Nature had ſo much need of it to relieve the diſtended *Guts*, and Art had contributed to that Intention by Clyſters and Purgatives given.

Which ſerves to illuſtrate what has been ſaid above, concerning the defective and convulſive Motion of the *Guts* in Hyſterick Caſes, where, through a Defect in the Quantity or Quality of the *Bile*, or from both theſe, the Motion of the *Guts* becomes defective, irregular or convulſive, but is not totally loſt through a total Want of it, as in this Caſe.

III. He never went to Stool after he received the Wound; and the ſtrongeſt Purgatives and Clyſters that could be reaſonably given, had no Effect.

This ſeems alſo to be owing to the Want or total Loſs of the periſtaltic Motion; and plainly ſhews, that the ſtrongeſt purging *Stimulus* has not the Power

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to reſtore it, without the Aſſiſtance of the *Gall*: For had it been in any Degree reſtored, the *Belly* would have fallen proportionally, and ſome Evacuation of what was lodged in the *Primæ Viæ* would have followed.

If then the Power of Purgatives depends upon the Co-operation of the *Bile*, it will follow, that where it is moſt active or redundant, their Operation will be, *cæteris paribus*, greateſt; and where it is unactive or deficient in Quantity, they will have proportionally a leſs Effect. Though it be true that a great Quantity, or morbid Acrimony of the *Bile*, by a too ſtrong and violent Irritation, will bring the *Inteſtines* into ſuch Spaſms, as to ſtop all Excretion by Stool; and the ſtrongeſt purging *Stimulus* added to it does only encreaſe the Spaſms and Coſtiveneſs; as in *Bilious* Cholics, which are always attended with exceeding Coſtiveneſs, not conquerable by the ſtrongeſt Purgatives, if they be not joined with Opiats, to allay the Spaſms, and obtund the Acrimony of the *Bile*.

He took what was thought a ſufficient Quantity of liquid Food and Drink; but if the Elater of the *Guts*, and their periſtaltic Motion were loſt, it is eaſy to prove that none of his Food or Drink could enter the *Lacteals* for want of the periſtaltic Motion; and therefore that he died ſtarved. And this will account for all the reſt of the Symptoms mentioned.

To prove that this was his Caſe. All that have ſeen live Diſſections, intended to ſhew the Nature of the periſtaltic Motion, and the Courſe of the *Lacteals*, muſt have obſerved, that the *Guts* have an alternate Syſtole and Diaſtole, or Contraction and Dilatation called the periſtaltic Motion, the ſuperior Section con-

contracting itſelf, while the immediate inferior is dilated; and this Motion is carried on in ſeveral Parts of the *Guts* at the ſame time; and the contracting Part, by expelling the *Blood* and *Chyle* out of its Sides, in its Contraction looks pale, while the Parts dilated look florid, and the Veſſels full of *Blood* and *Chyle*.

Now the Part contracting muſt neceſſarily force the *Chyle* from the groſſer Parts of the Food or Aliments, towards the inner Surface of the *Guts*, where the perforated capillary Extremities of the *Lacteals* in the *villous Coat* are ready to admit, or rather to abſorb it by Attraction, as far as the larger and viſible Branches of the *Lacteals* on the Coats of the *Guts*, into which it eaſily flows in the Time of Dilatation, or Diaſtole, which expands and unfolds theſe Veſſels at that Time for its eaſy Reception; from which it is farther propelled by the next Syſtole, or Contraction, into the primary or firſt Order of the *Lacteals* in the *Meſentery*; and by the ſame repeated Impulſes of the contracting Sections of the *Guts*, is forced farther through the ſecond Order of *Lacteals* in the *Meſentery*, into the *Receptaculum Commune*, and the *Thoracic Duct*; aſſiſted by Valves, and promoted by the inceſſant Motion of the *Muſcles*, and of all the Contents of the *Abdomen* and *Thorax* in Reſpiration, it is at laſt poured into the *ſubclavian Vein*, for a perpetual Recruit of the *Blood* in a healthy State.

But if the firſt Movers in this Series fail, that is, if the muſcular Fibres of the *Guts* have loſt their periſtaltic Motion, as in this Caſe, then the Expreſſion, Abſorption and Progreſs of the *Chyle* deſcribed, cannot ſucceed, the *Blood* muſt be deprived of its Recruit, and the Perſon die ſtarved; which, as I have

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ſaid before, ſeems to have been this Perſon's Caſe, and will ſufficiently account for the reſt of the Symptoms above recited.

Firſt, His Want of Sleep, and the Inability of *Opium* to procure it, might be owing to a Want of Recruit of *Chyle* in the *Blood:* As we ſee that thoſe who live ſparingly, ſleep very little, and thoſe who feed plentifully, require by ſo much a greater Number of Hours to ſleep; and in all chronical Caſes, where the Body ceaſeth to be nouriſhed, the Sleep alſo fails, and Opiats have but little Power; whereas in Children, where a great Part of their Food goes towards both Nouriſhment and Acretion, the greater Part of their Time is ſpent in Sleep.

It may indeed ſeem difficult to conceive how a Want of Reſt ſhould enſue ſo ſoon after the Accident. But conſidering that the Loſs of one Meal in a Day, eſpecially of Supper, to ſuch as have been accuſtomed to ſup, has occaſioned fewer Hours Reſt in the following Night, it will follow, that ſuch Perſons require at leaſt ſome ſmall Recruit once in ſix or ſeven Hours, in order to reſt their uſual Number of Hours; and therefore in our Caſe, where all Recruit muſt have ceaſed ſoon after the Accident, he might be ſenſible of the Impairment of Reſt in ſix or ſeven Hours after it, and thoſe about him might well obſerve the Encreaſe of that Symptom, at leaſt in the following Night.

Another Difficulty ariſeth from the Obſervation of *Swallows* and *Tortoiſes*, *&c.* who ſleep moſt in Winter, when they eat and drink nothing. In anſwer to which, there ſeems to be no Parity between the natural Conſtitution of their Blood and Humours, and that of Men: To theſe, and ſuch like Animals, with

regard to Recruit and Nouriſhment, Action and Reſt, the Spring and Summer are as one Day, and the Winter as one Night; and their Blood and Humours ſeem to be fitted by God and Nature, not only to bear, but even to require ſuch long Periods of Reſt and Action. And probably there is as little Parity between the Craſis and Conſtitution of the Blood and Humours of a healthy Perſon, and of thoſe in ſoporous and cataleptick Diſeaſes, who are reported to have ſlept for Weeks or Months without Food of any kind: And therefore, I ſay, where the Craſis and Conſiſtence of the *Blood* and *Spirits* are nearly the ſame, that is, *cæteris paribus*, he who feeds, and is nouriſhed moſt, will ſleep longeſt, & *e contra*.

The Poſition here advanced is farther confirmed by the Inefficacy of the Opiats given, they being capable of entering into the *Blood* through the Pores of the *Stomach* in Contact with them; by which quick Paſſage they have been obſerved to procure Reſt ſoon after they have been applied outwardly, or taken down into the *Stomach*, as in this Caſe they may juſtly be ſuppoſed to have done: Though, for the Reaſons above-mentioned, neither they nor any thing elſe could paſs by the *Lacteals*: But as the Aliments could not paſs that Way, *viz.* by the Pores of the *Stomach*, nor by the *Lacteals* into the *Blood*, there could be no Recruit nor Nouriſhment: And therefore the Opiats, though they did enter into the *Blood* by the Pores of the *Stomach* in Contact with them, could not procure Reſt. Thus it would ſeem probable, that Opiats do produce their Effect by detaining the *Chyle* crude longer than uſual in the Maſs of *Blood*, and thereby lengthening Sleep beyond the uſual Time;

and

and that they are ineffectual where there is no *Chyle* in the *Blood* to be detained.

But to explain how *Opiats* do contribute to retain the *Chyle* and other Crudities in the *Blood*, longer than uſual, would require a Diſquiſition too tedious for this Place: But their Power of retarding or ſuppreſſing all or moſt of the Secretions and Excretions; their palling or obtunding the Appetite; their enabling one to faſt long, and ſupporting one in Journies and Labour for a long Time without Food (Effects well known to the *Turks* and *Aſiaticks* in their Journies through Deſerts, &c.) theſe, I ſay, and ſome other known Effects of *Opium*, do very much favour this Opinion.

Secondly, The Want of *Pus* in the Wound was probably owing to a Want of Recruit of *Chyle* in the *Blood*; and the Flabbineſs and Paleneſs of its *Lips*, to a Shrinking of the Parts for want of daily Nouriſhment.

Thirdly, The ſmall Quantity of *Urine* was probably alſo owing to a Want of Recruit of *Fluids* from the *Primæ Viæ*: For theſe, in a healthy State, find their Way to the *Urinary Paſſages* very ſoon. The ſlight Tincture of Yellow, which it had, muſt have been from the *Bile* ſpilt in the *Abdomen*, and filtrated through the Duplicature of the *Peritonæum*, and Bottom of the *Bladder*: For it could not be ſuppoſed to derive its Colour from the *Blood*, into which no *Bile* could now enter by the common Way.

Fourthly, The Want of *Saliva*, and the ſilky Drineſs of the *Tongue*, ſeems to have been owing to the ſame Cauſe, a Want of Recruit of *Fluids* in the *Blood*, and a Loſs of ſo much of them as fell into the *Abdomen*.

Fifthly, If it be ſuppoſed that ſuch a ſmall Wound through the *Integuments* and *Muſcles* of the *Abdomen* and the *Peritonæum*, was capable of producing a *Fever*, then his not having any Symptoms of a *Fever*, muſt be owing to a total Defect of *Bile* and *Chyle* in the *Blood*, none of which could enter the *Lacteals* for want of the periſtaltic Motion, as has been ſaid.

Laſtly, The few Fits of Hickup, Reachings to vomit, and Intermiſſions in the *Pulſe* in declining and dying Perſons, ſeem to ariſe not only from a Defect, and therefore an unequal Diſtribution of the *Blood* and *Spirits*, but chiefly from the Corruption and irritating Acrimony of them, as the immediate Cauſe of Death in this and moſt other Caſes. Which will be farther explained in the following Pages.

OBJECTION I.

It may very reaſonably be objected here, that the *Ductus Hepaticus* would carry a Sufficiency of *Bile*, for the Uſes of the Animal OEconomy, into the Cavity of the *Inteſtines*, though none came by the *Ductus Cyſticus*; and Nature ſeems to have provided the *Ductus Hepaticus* for this Purpoſe, that if any Obſtruction or Defect ſhould happen in any of theſe Secretory Channels, the Secretion and Excretion might go on for the Benefit of the OEconomy, in the other: As Nature has provided two Kidneys, and double Organs of Senſe, for the ſame Reaſon. But the Effect will not be the ſame in a Wound, which is the Reverſe of an Obſtruction; becauſe by a perpetual Evacuation through it, ſuch a Revulſion and Derivation is made, as drains and deſiccates all the neighbouring Parts, and either leſſens

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or entirely fruſtrates the Secretion and Exeretion by them: And this we find to be true, where the Secretory Organs and Ducts concerned in the different Secretions, lie at a great Diſtance from one another; as in the *Diabetes* we generally ſee a very great Deſiccation of the *Salival Glands*, a Defect of *Saliva*, and a perpetual Thirſt; and Sweating and Looſeneſs leſſen the Secretion by *Urine*; an *Iſſue* drains and emaciates the neighbouring Parts; and it is mechanically demonſtrated by *Bellini*, that the Flux of the *Blood*, and of all the Humours, will be moſt and ſtrongeſt towards the Part where the Reſiſtance is taken off; as in Bleeding, to which this perpertual Flux of *Bile*, through the wounded *Gall-Bladder*, ſeems to have a great Affinity; and therefore would probably promote the Afflux of *Blood* and Secretion of the *Bile* ſo much and ſo ſtrongly towards the *Veſſels*, *Glands*, and *Secretory Ducts* leading to the *Cyſtis*, as very much to leſſen, or totally to hinder the Secretion by the *Ductus Hepaticus* into the *Guts* by that Channel: And therefore, in this Caſe, the whole of this uſeful Juice ſeems for this Reaſon to have been totally loſt to the Animal OEconomy.

OBJECTION II.

Another Objection is, that as the *Guts* and other Contents, and even the *Muſcles* and *Integuments* of the lower *Belly*, were highly tinged by the *Bile*, it is probable that ſome of it has got into the Cavity of the *Guts*, where it might, by its *Stimulus*, keep up the periſtaltic Motion, and by the *Lacteals* get into the *Blood*, for the Uſe of the Animal OEconomy; as

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it appears that ſome of it got into the *Bladder* in that Manner, and tinged the *Urine*.

It is not unlike that this might happen when the *Bile* came to be very redundant in the Cavity; but in paſſing through the Interſtices of the *Veſſels* and *Fibres* of the *Guts*, as through a *Filtre*, the groſſer, ſaline and ſulphurious Particles of it, which are the moſt pungent and active Parts, muſt have been left behind; which the muddy Thickneſs, as well as Deepneſs of the Colour of the Liquor found in the Cavity of the *Abdomen*, compared with the tranſparent Clearneſs of the *Urine* of a much lighter yellow Colour, without Sediment, does ſeem to prove: And it is not likely that ſuch a ſmall Quantity of filtrated *Bile*, as may be ſuppoſed to have paſſed that Way, deprived of all its active Particles, could either in Quantity or Quality be ſufficient to aſſiſt in any Function of the Animal OEconomy, whether Natural, Vital or Animal: And, in Fact, if any paſſed that Way, it appeared plainly inſufficient to promote the Contraction and periſtaltic Motion of the *Guts*, which remained preternaturally diſtended, as has been ſaid, from the Beginning to the Time of his Death.

OBJECTION III.

It has been alſo objected, that an Animal which dies ſtarved, dies delirious and feveriſh, the Experiment having been made on Cats and Dogs: And therefore this Perſon, who had no Fever, nor Delirium of any kind, cannot be ſuppoſed to have died ſtarved.

I will not diſpute theſe Facts, eſpecially the Experiments upon Cats and Dogs, though I have not made any myſelf, nor do I remember to have had any juſt

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or accurate Account of the Symptoms of ſuch who have died of Hunger and Thirſt, in Sieges, and at Sea; though many Inſtances have been, and no Notice, that I know of, has been taken of their having died mad, delirious or feveriſh, though theſe Symptoms are ſo remarkable and affecting. But ſuppoſing theſe Facts, theſe Caſes will differ very much from this before us: For an Animal ſtarved to Death purely for Want of Food, has the *Gall* flowing continually into the Cavity of the *Inteſtines*, unmixed and undiluted with *Chyle*, and from thence by the *Lacteals* into the *Blood*; ſo that in a few Days this acrimonious Juice muſt become more redundant there, than any other Humour; which joined with the conſtant Attrition of the Globules in Circulation, muſt ſoon render the *Blood* very acrimonious, rancid and alcalin; that is, muſt reduce the whole to a Maſs of Putrefaction, capable of ſtimulating the *Brain* and *Nerves*, ſo as to produce a Fever, Delirium or Madneſs: But in the Caſe under Conſideration, no *Gall* could enter into the *Blood*: And therefore this Degree of Putrefaction, and the Effects of it, could not happen; though it muſt be owned, that, through a Want of Recruit and Dilution, a lower Degree of Putrefaction of the *Blood* and *Humours* muſt have followed, even in this Caſe, from the continual Attrition in Circulation; ſuch at leaſt as was ſufficient to render the whole Maſs in a few Days unfit for any of the Uſes in the Animal Oeconomy, or the Functions of Life: And therefore may be juſtly ſuppoſed to have been the iuumediate Cauſe of Death: For all the paſſive Principles or Materials of Putrefaction, being actually in the Subſtance of the *Blood*, and all the active Princi-

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ples of Heat and Attrition being at work upon it to produce this Effect, it could not fail to be brought about in a few Days; and the ſame would happen to all Animals, is what is effete, corrupted or altered, ſo as to be unfit for the Uſe of the Animal, was not continually carried off by the *Emunctories*, and a freſh Recruit daily ſupplied from the *Primæ Viæ*; which Evacuations and Supply being kept up in their due Quantity and Proportion, do effectually prevent all Putrefaction and Acrimony, and keep the Blood and Humours in their natural Temperature, commonly (though miſtakenly) called Sweetneſs.

It is not then a Defect in the Quantity of *Fluids* which kills an Animal in Faſting, but a poiſonous Acrimony, which the *Blood* and *Humours* naturally contract, for want of a freſh Recruit and equal Evacuation. Thus in chronical Diſtempers, where the Perſon appears extenuated and exhauſted, the Quantity of the *Fluids* is certainly very ſmall, yet enough to maintain Life for ſome Months or Years, being kept in ſome Degree of Sweetneſs or proper Temperature, by a certain Proportion of Recruit and Evacuation: But where the Recruit is entirely ſubſtracted, the Evacuations will be proportionally leſſened: And therefore the Quantity of *Fluids* may remain much the ſame, but the Quality will alter, and Putrefaction for the Reaſons above aſſigned muſt take Place, and be the immediate Cauſe of Death, even long before the Maſs of *Fluids* can be much diminiſhed in Quantity, as in the Caſe before us. Which leads to the Anſwer of another Difficulty, *viz.*

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Objection IV.

How the *Pulſe* ſhould continue full, ſtrong and equal for ſeveral Days, while the Perſon was in a ſtarving Condition, and the *Blood* had no Recruit from the *Primæ Viæ?*

This indeed would be very unaccountable, if the Waſte of the *Blood* and *Humours* were ſuppoſed to continue at the ſame Height as before the Accident, and the Evacuations by the *Emunctories* were the ſame as in perfect Health. In this manner the Contents of the *Blood-Veſſels* would be ſoon waſted and exhauſted: But *Sanctorius*'s Obſervations and Experiments do ſhew, that the daily Recruits and Evacuations keep Pace with one another, and are nearly equal in 24 Hours in a healthy State: And therefore where the Recruits are plentiful, the Evacuations will be equally ſo; and where thoſe are ſparing the Evacuations are ſmall; or where the Balance is caſt too much of either Side, ſome Indiſpoſition or Diſtemper muſt follow. There is no Exception from this Rule, but in Children, a Part of whoſe Nouriſhment goes to Acretion, and the Encreaſe of their Weight: Therefore in the Caſe before us, the Recruit being entirely ſubtracted, the Evacutions muſt have been little, or next to nothing: And therefore the Quantity of the *Blood* and circulating *Humours* would remain much the ſame, and keep up the Fulneſs, Strength and Equality of the *Pulſe* for ſeveral Days, until the *critical Putrefaction* and *Colliquation* of the *Blood* above-mentioned, on the fifth or ſixth Day, rendered it unfit for a regular Circulation, and produced Intermiſſions in the *Pulſe*, Reachings to Vomit, and Hickup, all of them being local Convulſions, and

the Effects of Corruption, Acrimony, Irritation, and an unequal Diſtribution of the *Fluids*, which terminated in Death in the Beginning of the ſeventh Day.

The Sum of what has been ſaid is, that in this Caſe very little, if any, *Bile* entered into the *Inteſtines*, and that ineffectual; and none at all into the *Blood*. And as there was no apparent Defect in any Part of the Body, nor any Wound that could have been either dangerous or deadly, in any other reſpect than as it gave Occaſion to the Loſs and Miſplacing of the *Gall*; it is therefore evident, that all the Symptoms, and his Death, were entirely owing to the Loſs of this uſeful Juice; which it ſeems is ſo neceſſary to all Parts of the Animal Œconomy, Natural, Vital and Animal, that this Perſon could not live above ſix Days without it.

The practical Inferences that ſeem to flow by neceſſary Conſequences from this Obſervation, are,

I. That the periſtaltic Motion of the *Inteſtines* is as much owing to the Influx of the *Bile* into their *Cavity*, as to the Influx of the Animal *Spirits* and *Blood* into their *Sides*: And therefore that the *Bile* is to be looked upon as one of the prime Movers in the animal Œconomy, by which the elaſtic Springs of the natural Motions, to wit, the *muſcular Fibres* of the *Guts* are ſet to work; upon whoſe Motion all the ſubſequent vital and animal Motions do ſo far depend, that none of them can be long in Perfection where it is imperfect, nor ſubſiſt many Days where it is totally wanting.

II. This prime Motion is totally loſt by a total Want of *Bile*; proves ſluggiſh by a Defect in its Quantity; becomes irregular or convulſive by a great Redundancy

dundancy or morbid Acrimony of it. From whence ſeveral Diſtempers that are called *Nervous* may ariſe, and are more likely to be cured by correcting and evacuating the redundant or faulty *Bile*, and diſobſtructing the *Liver*, than by moſt other Medicines taken from the common Claſs of *Nervines*.

III. That the Power of Purgatives depends upon the Co-operation of the *Bile*: And therefore it is probable, that the Difference of Conſtitutions, at equal Ages, with reſpect to Purgatives, depends more upon the Quantity and Quality of the *Bile*, than on the Bulk or Weight of the *Body*, Quantity of the *Blood*, or other *circulating Humours*.

IV. It alſo appears that the Nouriſhment and Acretion of the Body do in ſome Meaſure depend upon a due Quantity and proper Quality of this Juice, without which the *Blood* and circulating *Humours* could not be recruited from the *Primæ Viæ*: And therefore that Defects in it may be frequently the Cauſe of a *Maraſmus*, or Waſte of the Body, where it is little ſuſpected: Which may ſerve to point out the Method of Cure in ſuch Caſes.

V. This Obſervation ſeems to lead to the Knowledge of the immediate Cauſe of natural Reſt or Sleep in a healthy State; to wit, a certain Quantity or Proportion of freſh *Chyle* in the *Blood*; the Want of which, from whatever Cauſe, will occaſion Watchfulneſs, or ſome Degree of it. And this may ſerve to point out the immediate Effect and Conſequences of *Opiats*, whence may be gathered how far, and in what Caſes they may be effectual and uſeful; and in what Circumſtances they may be ineffectual, uſeleſs or hurtful. Which may deſerve a farther Illuſtration.

VI. That a due Quantity of *Aliments*, at proper Intervals of Time, is neceſſary to keep the *Blood* and *Humours* in their natural Temperature and Sweetneſs, and to preſerve them from Acrimony and Putrefaction: And this will be true in all Diſtempers as well as in Health, and is againſt the Practice of ſuch as pretend to ſtarve away Diſtempers, or to deny a due Quantity of Drink and liquid Food to the Sick, eſpecially in Fevers; where the Want of this Recruit will tend to encreaſe the Acrimony or Putrefaction, whence the Malignity of moſt Fevers does ariſe.

VII. That *Pus*, or Matter in a Wound or Ulcer is the Product of *Chyle*, and not of the *Blood* or *Serum*: Which has indeed been the received Opinion, though ſupported by no other Proof than the Similitude of *Pus* to *Chyle*. And as a great Redundancy, as well as a Defect of *Pus*, does ſometimes retard the Cure of a Wound or Ulcer, this may ſerve to ſhew by what Means it may be encreaſed or diminiſhed, to anſwer the Intentions of the Artiſt.

This alſo makes it appear probable, that a great Redundancy of *Chyle* diſpoſeth the Body to purulent, ſuppuratory and ſcrophulous Diſtempers; and ſeems to indicate the ſubtracting ſuch Sorts of Food as afford a rich, groſs or plentiful *Chyle*, and the adminiſtring of ſuch Medicines as may ſtrengthen Sanguification, and the other aſſimulating Powers, to aſſimulate and thereby conſume it; the Sanguification and aſſimulating Powers being manifeſtly weak, as the Chylification ſeems to be ſtrong in all ſuch Caſes. And this ſeems to be the Reaſon why in *Adults*, as the Sanguification grows ſtronger, and in *Age*, as the Voraciouſneſs of the *Appetite*, too common in

Youth, declines, theſe Diſtempers do often decreaſe, and at laſt wear out of themſelves: Which ſhews what Aſſiſtances Art ought to contribute, to bring about the ſame Effect in a leſs Time.

I muſt here own my Omiſſion to open the *Stomach* and *Guts*, in order to view the State of their Contents, where the *Gall* was entirely wanting, which might have given ſome Light to this Obſervation. This Omiſſion happened through ſome Hurry at the Time, which I regret; but am apt to believe, that as moſt of his *Aliments* were Liquids, the Alterations would not have been very conſpicuous or obvious to the Sight. And I hope it will not be impracticable to make ſome Experiments on live *Animals* for this Purpoſe, with more Care and Attention, for ſupplying what may have been defective in this Obſervation.

III. *Obſervatio Lunaris Eclipſeos, Ulliſſipone habita die* 2 Februarii, An. 1730, N. S. *in Collegio Divi* Antonii *magni à Rev. P.* Joanne Baptiſta Carbone, Soc. Jeſ. *Ex ejuſdem Cl. Viri Epiſtola ad* Jacobum de Caſtro Sarmento, *M. D. Coll. Med.* Lond. Lic. & *R. S. S.*

Temp. Ver. P. M.

H.	′	″	
13	25	0	Incipit penumbra ſenſibilis.
	40	0	Fit ſpiſſior.
	58	0	Fit ſpiſſiſſima.

Dubi-

Temp. Ver. H.	P.	M.	
14	3	45	Dubitatur de Eclipſis initio.
	4	32	Nunc certo incipere videtur.
	6	0	Jam diſcus Lunæ apparet deficiens.
	9	47	Umbra attingit plagam Borealem Terræ Pruinæ.
	10	25	Pervenit ad Harpalum.
	11	6	Medium Harpali tenet.
	16	15	Attingit Litus Boreale Sinus Iridum.
	18	34	Heraclides totus tegitur.
	22	38	Plato incipit.
	23	50	Medius Plato latet.
	24	54	Totus Plato obumbratur.
	29	40	Umbra ad Ariſtarchum.
	31	55	Ad medium Ariſtarchi.
	33	42	Totum Ariſtarchum occulit.
	34	55	Ariſtoteles obumbrari incipit.
	36	24	Medius Ariſtoteles tegitur.
	37	49	Ariſtoteles totus in umbra.
	39	9	Eudoxus totus.
	43	57	Umbra attingit Endymionem, & Ariſtillum ſimul.
	44	53	Medius Endymion, & totus Ariſtillus latet.
	45	48	Endymion totus.
	48	27	Timocharis totus ; umbra pervenit ad Litus maris Serenitatis.
	55	50	Ad Lacum Somniorum.
	56	30	Ariſtarchus incipit emergere.
	58	20	Medius Ariſtarchus extra umbram.
15	0	34	Ariſtarchus totus emergit.
	4	25	Poſſidonius incipit obumbrari.

Lacus

Temp. Ver. H.	′	″	*P. M.*
15	11	35	Lacus Somniorum totus, & dimidium Poſſidonii occultatur.
	13	12	Timocharis incipit emergere.
	16	5	Timocharis emergit totus; & totus Poſſidonius occultatur.
	27	54	Archimedes totus extra umbram.
	30	49	Poſſidonius incipit emergere.
	32	58	Heraclides totus.
	34	3	Poſſidonius totus.
	40	46	Harpalus totus.
	46	21	Platonis initium.
	47	16	Platonis medium.
	48	33	Plato totus extra umbram.
	50	55	Lacus mortis totus.
	52	37	Ariſtoteles incipit emergere.
	54	29	Ariſtoteles medius extra umbram.
	56	58	Ariſtoteles totus.
16	1	48	Endymionis initium.
	3	14	Endymion totus.
	4	0	Finis Eclipſis.

Duratio Eclipſis 4 H. 59′ 28″
Medium Eclipſis 15 H. 4′ 16″
Quantitas Digit. 3 Min. 20. ad Boream.

IV. *Ob-*

IV. *Obſervationes Cœleſtes Multifariæ inter Menſes* Novemb. 1727, & Novemb. 1728, Pekini *in* SINIS, *habitæ & ad Rev.* P. Joannem Baptiſtam Carbone, Soc. Jeſ. *tranſmiſſæ. Ex eadem Epiſtola deſcriptæ.*

I. *Immerſiones, & Emerſiones Satellitum Jovis obſervatæ* Pekini *in Sinis.*

SATELL. I.

		D.	H.	′	″	
Immerſiones.	*Nov.*	2	10	21	10	Veſp.
		10	0	14	26	Mane.
		11	6	44	10	Veſp.
Emerſiones.	*Dec.*	3	2	30	42	Mane.
		10	4	22	5	Mane.
		11	10	50	0	Veſp.
		13	5	17	50	Veſp.
		19	0	40	44	Mane.
		20	7	8	20	Veſp.
		26	2	32	33	Mane.
		27	9	0	0	Veſp.

			D.	H.	′	″	
1728.	Emerſiones.	*Jan.*	3	10	51	50	Veſp.
			5	5	20	0	Veſp.
			11	0	45	18	Mane.
			12	7	13	27	Veſp.
			19	9	5	40	Veſp.
			26	10	59	0	Veſp.
			28	5	27	20	Veſp.
		Feb.	4	7	22	0	Veſp.
			11	9	16	40	Veſp.
			18	11	12	30	Veſp.
			20	5	41	50	Veſp.
		Mart.	21	7	58	55	Veſp.
	Immerſiones.	*Sept.*	20	1	12	12	Mane.
		Oct.	4	5	6	0	Mane.
			13	1	30	0	Mane.
			20	3	26	15	Mane.
			27	5	19	30	Mane.

SATELL. II.

Immerſ.	1727.	*Nov.*	6	4	5	40	Mane.
	Emerſiones.	*Dec.*	1	3	40	45	Mane.
			4	5	2	0	Veſp.
			11	7	37	42	Veſp.
			18	10	11	13	Veſp.
			26	0	47	39	Mane.
	1728.	*Jan.*	5	4	42	0	Veſp.
			12	7	16	16	Veſp.
	Emerſiones.		19	9	51	0	Veſp.
		Feb.	13	7	3	45	Veſp.
			20	9	46	0	Veſp.
	Immerſio.	*Oct.*	30	3	34	10	Mane.

SATELL. III.

		D.	H.	′	″	
1727.						
Incipit	*Nov.*	21	7	57	0	Veſp.
emergere		28	11	53	0	Veſp.
1728.						
Immerſ. tot.	*Jan.*	3	5	43	40	Veſp.
Emerſ. prima			7	42	0	Veſp.
Immerſ. tot.		10	9	42	52	Veſp.
Emerſ. prima			11	42	20	Veſp.
Immerſio	*Feb.*	22	9	42	30	Veſp.
totalis.	*Oct.*	9	6	6	30	Mane.

II. *Obſervatio Eclipſis Lunæ die* 19 Aug. 1728, *habita* Pekini *in Obſervatorio publico.*

Horol. H.	′	″	*Corr.*
			Non multo ante Eclipſim dimenſa diameter Lunæ erat 30′ 50″.
10	54	0	Penumbra jam inficiebat partes Lunæ primo inumbrandas.
11	2	0	InitiumEclipſis paulo infra Cleoſtratum.
	13	0	Umbra attingit Ariſtarchum.
	14	30	Obtexit totum.
	15	20	Attingit Platonem.
	16	50	Obtexit totum.
	22	20	Attingit Galilæum & Timocharim.
	23	20	Pitheam.
	26	30	Kepplerum.
	27	30	Ariſtillum.
	31	30	Hevelium, Copernicum, & Endymionem fere ſimul.
	36	20	Ricciolum.
	38	15	Poſſidonium.
	40	10	Grimaldum, & Mercurium.
	41	40	Manilium.

Mene-

H.	′	″	
11	43	40	Menelaum.
	47	0	Plinium, & Geminum.
	52	0	Umbra ad centrum Lunæ, obtecto Grimaldo toto.
	54	20	Attingit mare Crisium, Ariadæum [Grimaldi apice australi hærente ad
	56	40	
	57	0	Proclum marginem umbræ.
12	0	0	Culminante Luna recta per medium Tychonem tendens inter Munosium, & Profatium ad Copernicum coincidit cum plano Meridiani.
	2	30	Umbra attingit Promontorium acutum, } Lente admodum emergente Grimaldo.
	4	30	Censorinum & Tarantium,
	6	0	Mare Crisium totum obtectum,
	15	30	Umbra attingit S. Theophilum,
	16	0	S. Cyrillum,
	21	30	Langrenium. Grimaldo integre emerso.
	25	15	S. Catharinam, Ricciolo toto retecto.
	31	0	Circa medium Eclipsis micrometro dimensa quantitas obscurationis erat Sinice digit. $6\frac{1}{2}$ ferme, sive more Europæo digit. $7\frac{1}{4}$.
12	34	0	Emersit Hevelius totus.
	36	0	Umbra ad Fracastorium.
	43	0	Galilæus } integre detecti.
	46	30	Lansbergius
	52	0	Keplerus
13	1	0	Aristarchus
	2	0	Copernicus incipit emergere.
	5	0	Totus detegitur.
	10	0	Margo umbræ per centrum Lunæ.
	11	30	Pitheas emersit.
	15	0	Eratosthenes & S. Cyrillus detecti.

H.	′	″	
13	20	0	Timocharis & S. Theophilus detecti.
	22	20	Ariadæus
	25	0	Manilius
	29	30	Ariſtillus integrè emerſerunt.
	32	0	Plato
	33	0	Cenſorinus
	34	0	Promontorium acutum.
	38	0	Plinius, & Langrenius integrè detecti.
14	0	0	Finis Eclipſis proximè Beroſum.

In fine Eclipſis diameter Lunæ inventa eſt 30′ 38″.

Durante Eclipſi ſæpius addenſati vapores turbabant faciem Lunæ, ut ejus maculæ, & umbræ margo non ſatis diſtinctè poſſent diſcerni; maxime id accidit ante, & circa finem Eclipſis.

III. *Aliquot Occultationes fixarum per Lunam, obſervatæ* Pekini, *A. C.* 1728.

Januar. die 2 Mane Luna occultavit Stellam *c Leonis* Immerſio erat 2^h 35′ 20″ in recta per Tychonem & S. Theophilum Emerſio fuit 3^h 20′ 40″ in recta per S. Theophilum & Eratoſthenem.

Die 22 Summo Mane Luna tranſivit per *Pleiadas*.

1^h 0′ 25″ immerſit *Taygeta* poſt Lunam, in recta cum Bullialdo, & Abilfedea.

1^h 9′ 30″ *Celæno*, à Cuſpide cornu auſtrali pauculis ſecundis diſtans in recta ex Tychone per Clavium, mox diſparuit nimia fluctuatione lucidi limbi Lunæ abſorpta.

1^h 18′ 24″ immerſit *Sterope* in recta cum Bullialdo, & Fracaſtore.

1^h 25′ 56″ *Maia* in recta ex Tychone per Longomontanum. Emerſio nullius videri poterat ob nimiam fluctuationem lucis Lunæ inter vapores.

Die 29 V eſp. Luna obtexit Stellam τ *Leonis* Immerſio

sio fuit 9^h 27′ 53″ in recta cum Galilæo, & Lansbergio. Emersio verò 10^h 24′ 17″ in recta cum Macrobio & Sosigene.

Mart. die 21 Vesp. occultavit Luna Stellam γ *Cancri.* Immersio fuit 8^h 14′ in recta per Copernicum & Boreum marginem Langreni. Emersio fuit neglecta.

Maii die 24 Summo Mane 1^h 51′ 30″ Luna absorbuit Stellam τ *Scorpionis* proxime Byrgium. Emersio non fuit observata.

Sept. die 14 Vesp. Luna occultavit Stellam η *Capricorni.* Immersio fuit 8^h 11′ 20″ inter Seleucum & Cardanum. Emersio 9^h 37′ 30″ paulo infra Langrenum.

Die 19 Vesp. Luna obtexit Stellam δ *Piscium.* Immersio fuit 8^h 43′ 45″ in recta per Tychonem & Langrenum. Emersio autem 9^h 5′ 15″ in recta cum Tychone & Keplero.

Oct. die 28 Manè Luna occultavit Regulum, seu Cor *Leonis* Immersio fuit 1^h 39′ 50″ in recta per Aristarchum & Gassendum. Emersio 2^h 11′ 15″ in recta per Aristarchum & Cardanum.

V. *An Account of the Veins and Arteries of* Leaves. *By* Frank Nicholls, *M. D. Præl. Anat.* Oxon. *F. R. S.*

BY a Letter from Dr. *Fuller* in *Holland* to the President, and communicated about *October* last, the Society was informed, that the ingenious Professor *Ruysch* had observed something in the dissecting of Leaves analogous to the Veins and Arteries of Animals; but without explaining in what Manner these different Vessels were disposed, or by what Means they may be distinguished from each other.

When

When I had the Pleafure of examining the Collections of *Frederick Ruyſch* and *Albert Seba* at *Amſterdam*, in both which were great Variety of diſſected Leaves, they made no Mention of ſuch Diſcovery; although in a Leaf from the Collection of *Ruyſch* I could (with a Glaſs) obſerve the Fibres to be double towards the Edges of the Leaf; which at that Time I imagined to be an unnatural Diviſion of the Fibres, as in decayed Sticks.

In the mean Time; *Albert Seba* having communicated the Method of diſſecting Leaves to the Society, by a Letter to the Preſident, I ſeparated the pulpous from the fibrous Parts of ſeveral Leaves after his Method; when examining them by Glaſſes, and in Water, I found that each Fibre was naturally ſeparated into two diſtinct Fibres by a thin *Stratum* of the pulpous Subſtance; and that this Separation was continued through all the Fibres and Stem of the Leaf, ſo as to form two diſtinct Planes of ſimilar Net-work.

Though this Duplication of the Veſſels in Leaves ſeems to point out an Analogy between them and the Veins and Arteries of Animals, yet I ſee no probable Means of gueſſing which are the arterial and which the venal Fibres.

That I might illuſtrate this Matter, as it appeared to me, I have prepared two Leaves, the one of an Apple, the other of a Cherry; in which, as well the Separation of the Fibres and Stem, as the pulpous Subſtance, by which they are naturally ſeparated, are very obvious. *See Plate* II. A *the Cherry-Leaf*; B *the Apple-Leaf, whoſe Planes are ſeparated.*

Both which (the Society having nothing of this Nature in their Repoſitory) I deſire may be accepted as a Mark of the Reſpect of their

Moſt Humble Aſſociate,

June 11, 1730. F. NICHOLLS.

Jos: Banks

Numb. 415.

PHILOSOPHICAL TRANSACTIONS

FOR THE

Months of *September* and *October*, 1730.

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I. *An Account of ſome uncommon* Anaſtomoſes *of the Spermatic Veſſels in a Woman, obſerved by* Cromwell Mortimer, *M. D. R. S. Secr. & Coll. Med. Lond. Soc.*

II. *Memoirs communicated by Monſ.* Garcin *to Monſ.* St. Hyacinthe, *F. R. S. containing a Deſcription of a new Family of Plants called* Oxyoïdes; *ſome Remarks on the Family of Plants called* Muſa; *and a Deſcription of the* Hirudinella Marina, *or* Sea Leach. *Tranſlated from the* French, *by Mr.* John Martyn, *F. R. S.*

III. Typus

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IV. Obſervatio ejuſdem Defectûs Solis habita Patavii, ab J. Poleno.

V. *An Explanation of the new Chronological Table of the* CHINESE HISTORY, *tranſlated into* Latin *from the Original* Chineſe, *by Father* Johannes Franciſcus Foucquet, *Soc. Jeſ. Biſhop of* Eleutheropolis, *and publiſhed at* Rome *in the Year* 1730. *Collected from two Accounts thereof, written in* French, *one ſent from* Rome *by Sir* Tho. Dereham, *Bar^t. to the Royal Society, the other ſent from Father* Foucquet *to Father* Euſtache Guillemeau, *a* Barnabite *at* Paris, *and by him tranſmitted to Sir* Hans Sloane, *Bar^t. Pr. R. S.*

VI. *An Account of Mr.* Mark Cätesby's *Eſſay towards the Natural Hiſtory of* Carolina *and the* Bahama *Iſlands, with ſome Extracts out of the firſt three Sets. By Dr.* Mortimer, *R. S. Secr.*

I. *An*

Tab. I.

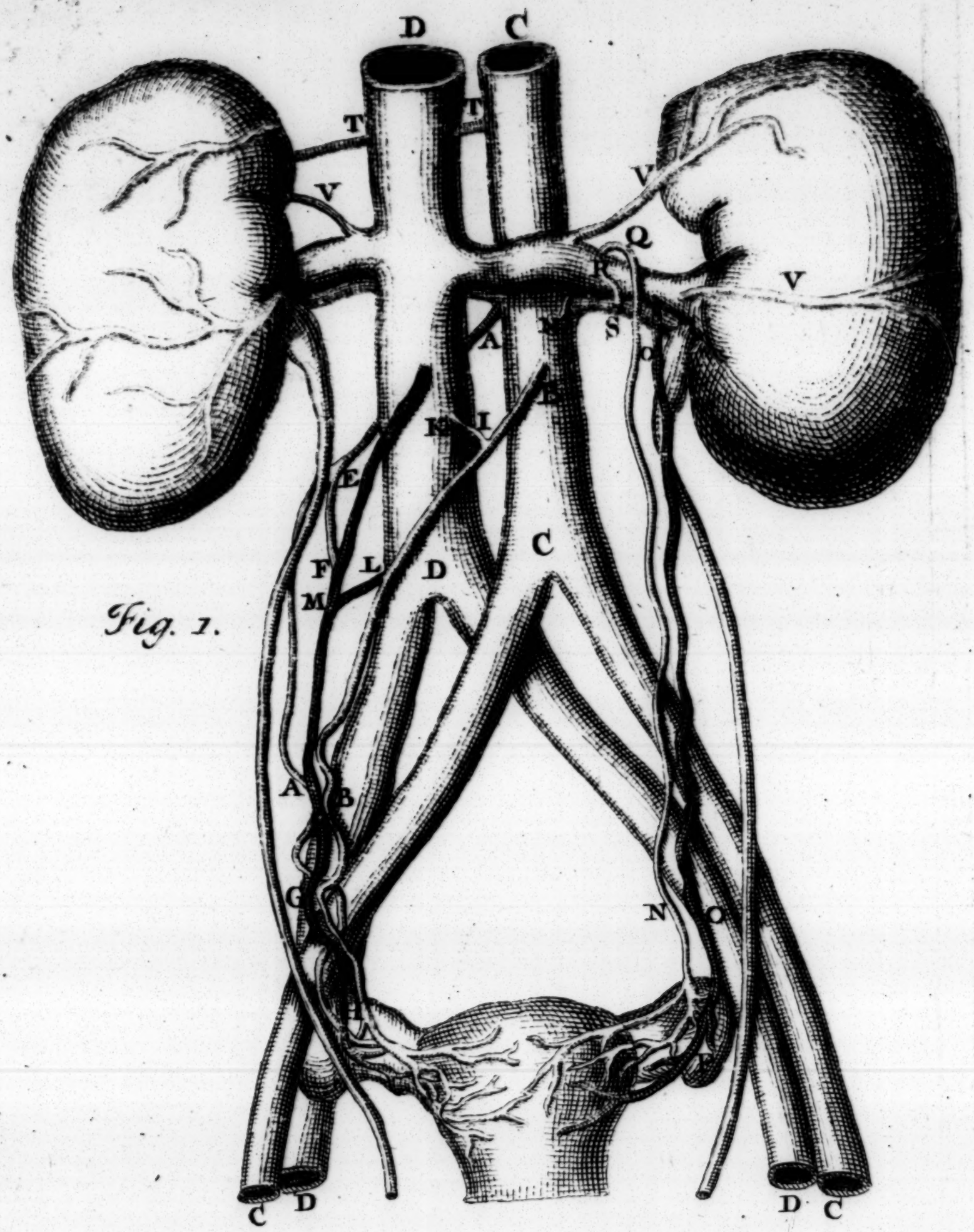
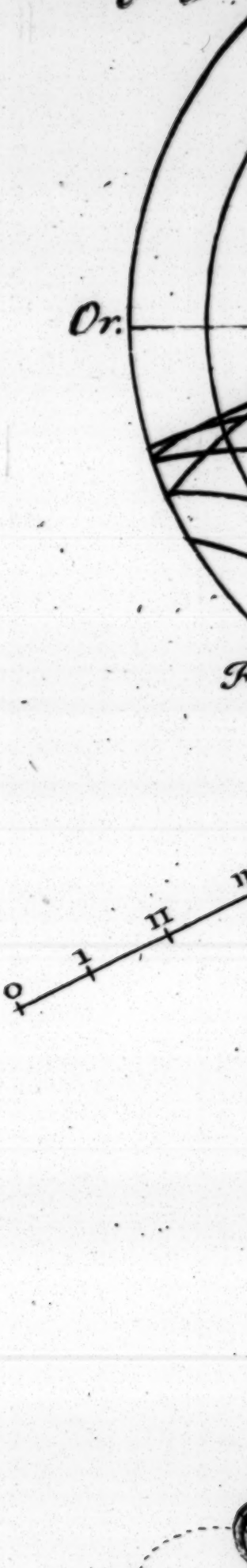


Fig. 1.

Fig. 3



C M. delin.

Fig. 3.

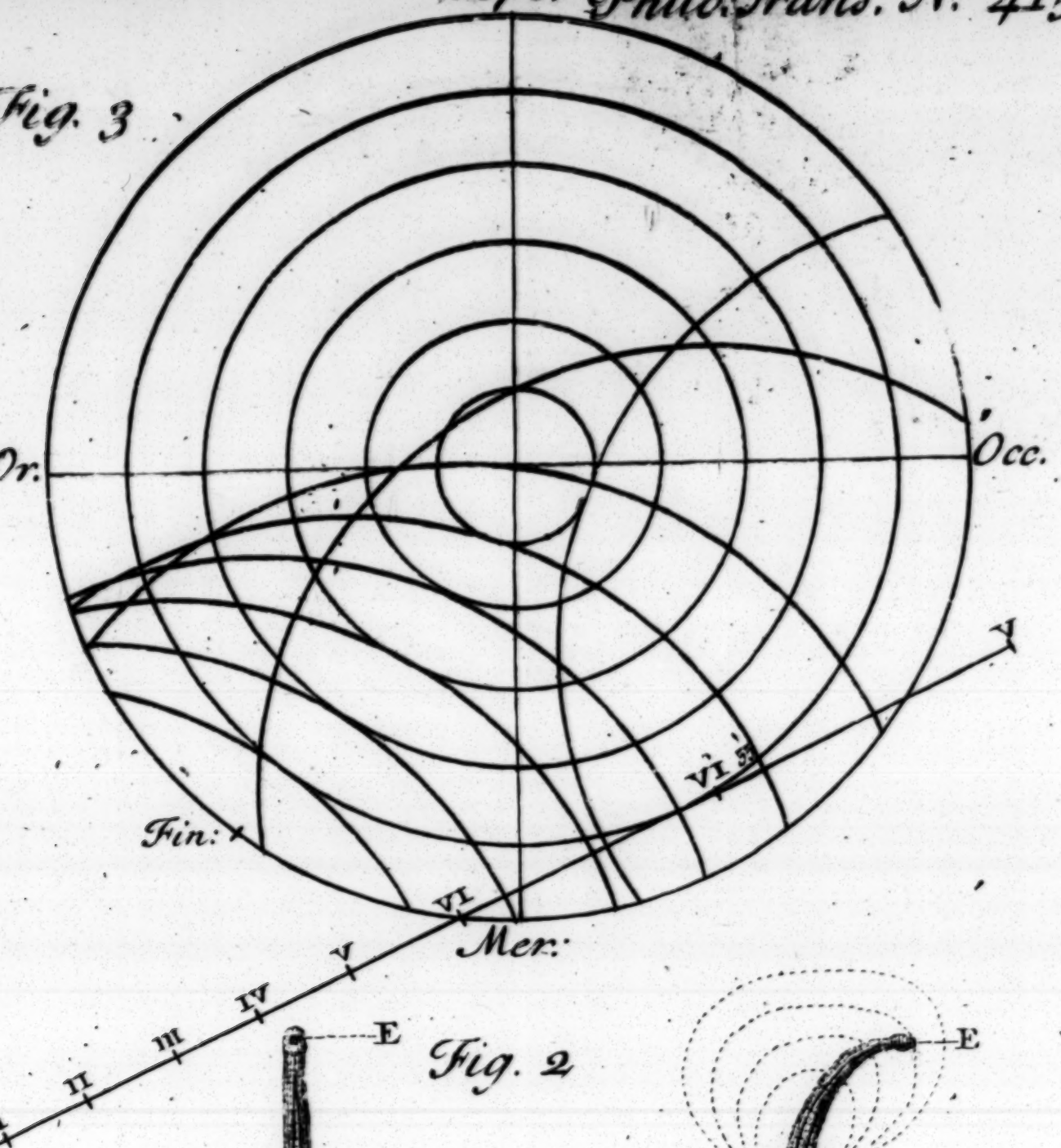
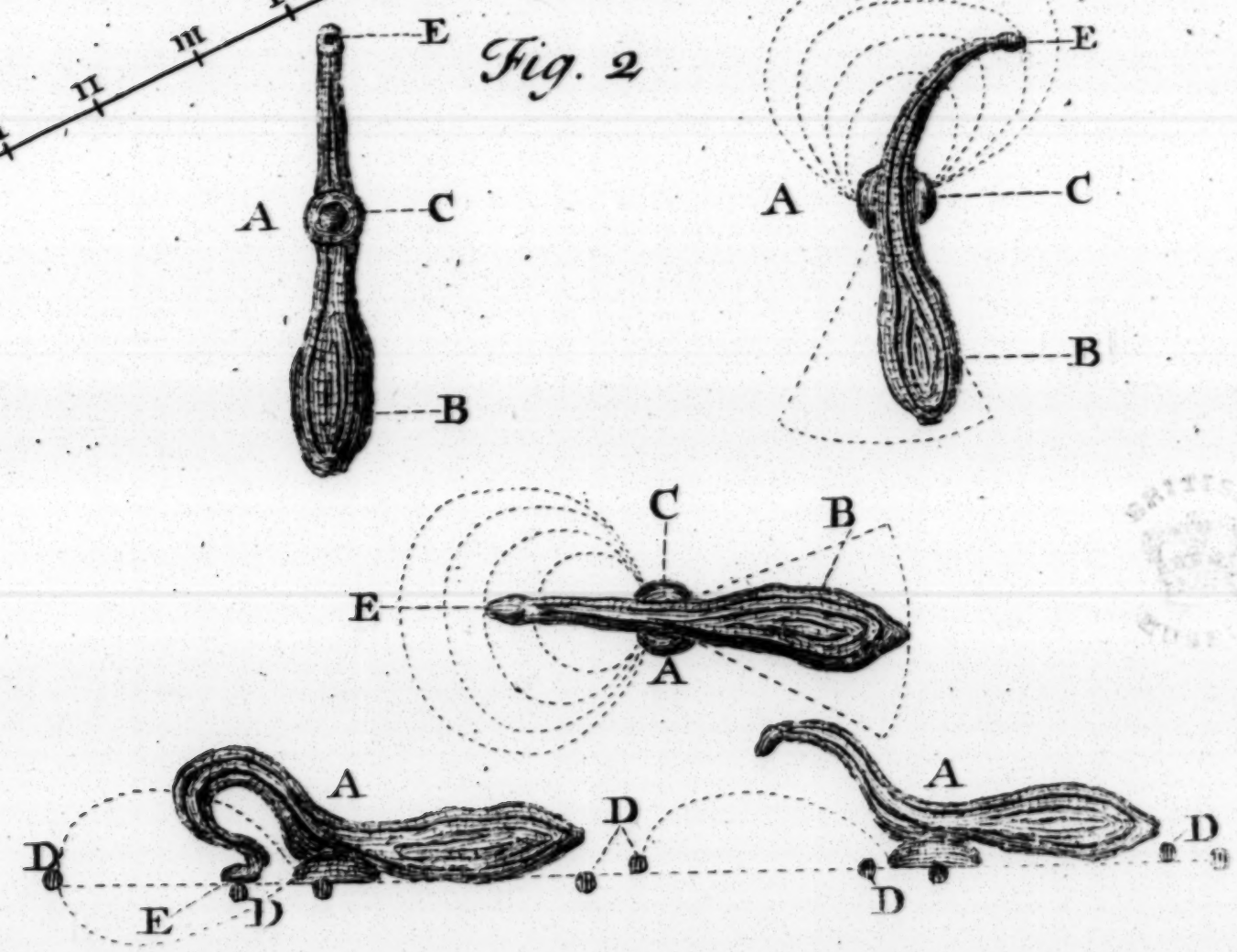


Fig. 2.



Tab. I.

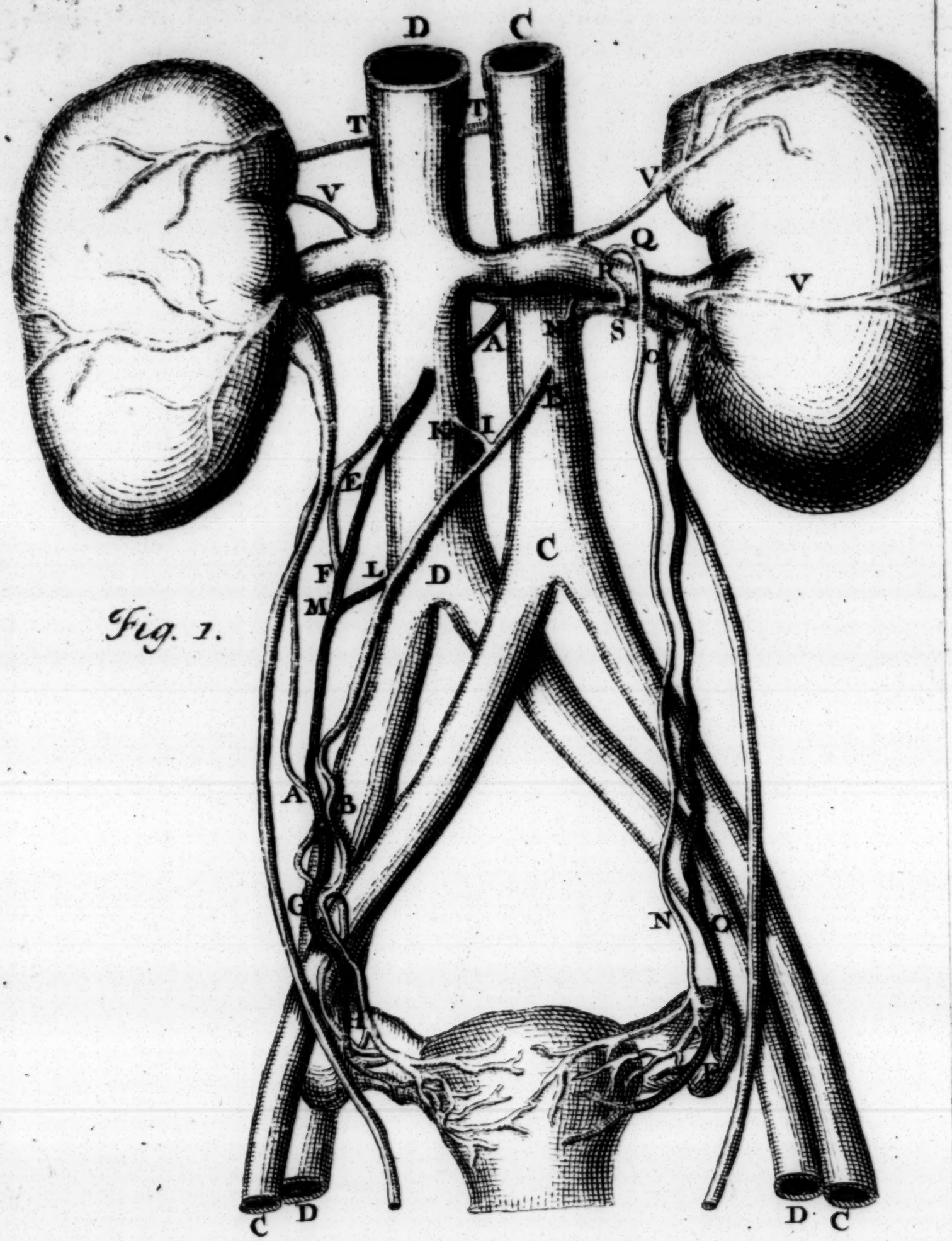


Fig. 1.

C M. delin.

I. *An Account of ſome uncommon* Anaſtomoſes *of the Spermatic Veſſels in a Woman, obſerved by* Cromwell Mortimer, *M. D. R. S. Secr. & Coll. Med. Lond. Soc.*

EUSTACHIUS, that moſt accurate Anatomiſt, is the only Author I have met with, who has given us any Delineation of an immediate Communication between the Spermatic Arteries and Veins, during their Courſe along the Cavity of the *Abdomen*; which is diſtinctly laid down in his anatomical Tables (*Romæ in Folio* 1714.) *Tab.* XII. *Fig.* 1 & 3. *Tab.* XIII. *Tab.* XXV. *Boerhaave* from him makes mention of theſe *Anaſtomoſes* in his *Inſtitut. Med.* § 642; and alſo cites *Leal Lealis* in his Treatiſe Περι Σπερματιζοντων Οργανων (*Lugd. Bat.* 8vo. 1707) *p.* 18 *ad* 26; where he fully refutes *de Graaf*, who denies theſe *Anaſtomoſes*: but even *Leal* owns, he never ſaw them, and only argues for them from the Effect, and the cloſe Union of the Spermatic Vein and Artery in one Covering as they run together. *Marchetti* in his Anatomy (*Hardevicæ* 12°. 1656.) *Chap. of the Parts of Generation in a Man*, aſſerts this *Anaſtomoſis*, *p.* 58, but neither do I find that he ever ſaw them; nor have I hitherto converſed with any, even Anatomiſts, the moſt celebrated for their Injections, who had hit on a Subject, where theſe Paſſages were open enough to tranſmit the ſubtile Matter they inject with.

In the Beginning of the Year 1723, being at *Paris*, and at the *Hotel Dieu* having an Opportunity of diſ-

 ſecting

fecting various Bodies, I light on a female Subject, where theſe *Anaſtomoſes* were as large as the ſpermatic Veſſels themſelves; ſo that the Arteries being injected with a groſs Mixture of Wax, Tallow and Vermilion, and the Veins with the ſame, only tinged with Smalt, the Injection ran out of the Artery into the Vein, and on the other Hand out of the Vein into the Artery, ſo that where one Veſſel entered the other, the Matter injected was tinged purple. You muſt obſerve the Arteries were firſt injected with the red, and the Veins afterward with the blue Matter.

In this Subject what appeared moſt remarkable, was, that on the right Side were two ſpermatic Arteries A and B. One A, aroſe from the very Angle made by the Emulgent and the Trunk of the *Aorta deſcendens* C, which, contrary to the common Courſe, ran under the *Vena Cava*, and ſoon after it was got beyond it, ſent out a lateral Branch, or *Anaſtomoſis*, deſcending obliquely E F into the Spermatic Vein G, through which the red Matter penetrated into the Vein; which being afterwards filled with Blue, became Purple allabout the Orifice of this Veſſel at F, which ſeems to confirm *Euſtachius*'s Delineations, and ſhew they are no Fictions. This Artery A then deſcended as uſual to the right Ovary H.

The other right Spermatic Artery B aroſe as uſual out of the Trunk of the *Aorta*; but at about half an Inch from its Riſe, it ſent out an *Anaſtomoſis* I K, aſcending obliquely into the Body of the *Vena Cava* D, through which a large Quantity of the red Matter paſſed, ſo as to tinge a very broad Place at K in the *Vena Cava* purple. About an Inch below this Orifice

was

was another *Anaſtomoſis* L M, through which the blue Matter penetrated out of the Vein, and made the Contents of the Artery purple at L. The right Spermatic Vein had only this one *Anaſtomoſis* M L, in all other Reſpects as uſual. Here was ſomething ſurprizing to ſee the Courſe of the Channel inverted, if the Blood ran from the Vein M towards L, into the Artery; but ſurely this muſt be from ſome Accident in the Injection, for it could never be ſo in the Perſon's Life; only indeed the oblique Riſe of this Branch out of the Vein ſeems to ſhew, that the Blood aſcending in the Vein would have its natural Direction into the Orifice of that Channel, or at leaſt the Blood coming from the Artery would meet with a Stop, and ſo the two Streams retard each other.

On the left Side was but one Spermatic Artery N, and one Spermatic Vein O, which, as uſual, incloſed in a common *Involucrum*, made their Way to the left Ovary P. Only the Artery N took its Riſe out of the Body of the Aorta near the Angle made by it, and the left emulgent Artery, then aſcending between the emulgent Vein and Artery, turned in an Arch at Q, over the left emulgent Vein, and ſo joined the left Spermatic Vein as uſual, which roſe out of the left emulgent Vein, as it often happens.

There was on this Side one Thing very uncommon, and not taken Notice of by *Euſtachius* himſelf, which was a ſhort *Anaſtomoſis* R S (about a quarter of an Inch in Length) from the left emulgent Artery S, which making an Arch under the left emulgent Vein, was inſerted into the anterior Part of it at R.

The ſmall Branch ariſing out of the Aorta on the right Side at T, an Inch above the Emulgent, and its being inſerted into the upper Part of the Kidney, is what we have many Varieties of in *Euſtachius*'s Tables to his Book *De Structura Renum* (8*vo*. *Leid*. 1707) almoſt an Infinity of ſuch Variations, and likewiſe of ſmall Branches inſerted into the emulgent Veins, as at V, are daily met with, and have been obſerved by many Authors.

Explanation of Tab. I. *Fig.* I.

A B, Two Spermatic Arteries on the right Side.
C C C, The *Aorta* deſcending, and the two Iliac Arteries.
D D D, The *Vena Cava* aſcending, and the two Iliac Veins.
E F, L M, *Anatomoſes* of the Spermatic Veins and Arteries.
G G, The right Spermatic Vein.
H, The right Ovary.
I K, An *Anaſtomoſis* of the Spermatic Artery and *Vena Cava*.
N Q N, the left Spermatic Artery.
O O, The left Spermatic Vein.
P, The left Ovary.
R, S, An *Anaſtomoſis* of the emulgent Vein and Artery.
T T, V, V, V, } Arteries and Veins diſperſed on the Fat and Membranes encloſing the Kidneys.

Oxalis sensitiva L.

Oxyoides Malabarica sensitiva.
Caule viridi glabro altiore flore majore.

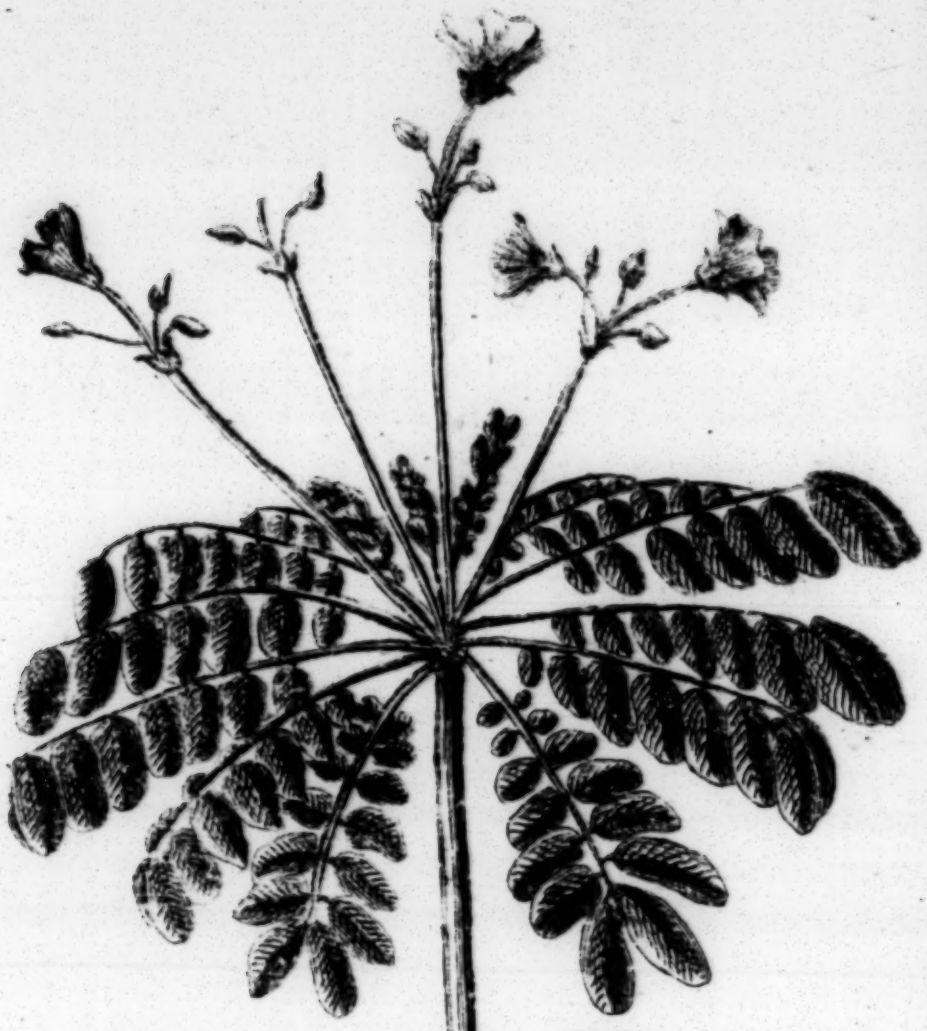


Fig. 2.

Fig. 3.



Ta

Oxyoides Javanica
rubescente hirsuta

Fig. 1



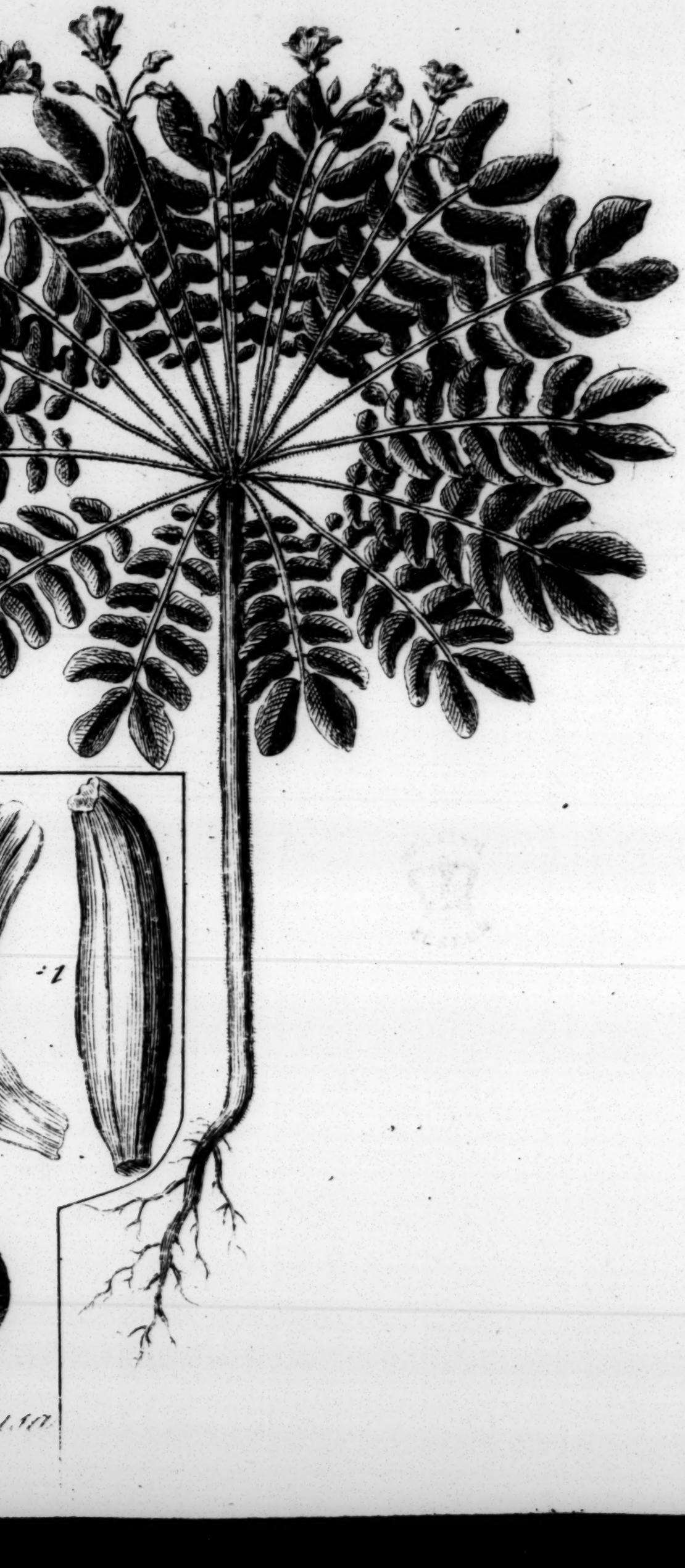
Fig. 4.



The Fruit of the Musa

Tab. II. Philo: Trans: N.o 415.

wanica Sensitiva. Caule
hirsuto, flore luteo minore.



Oxalis sensitiva L.

Oxyoides Malabarica sensitiva.
Caule viridi glabro altiore, flore majore.



Fig. 2.

Fig. 3.



Oxy
rube

Fig. 1

Fig. 4.



The Fruit o

II. *Memoirs communicated by Monſ.* Garcin *to Monſ.* St. Hyacinthe, *F. R. S. containing a Deſcription of a new Family of Plants called* Oxyoïdes; *ſome Remarks on the Family of Plants called* Muſa; *and a Deſcription of the* Hirudinella Marina, *or* Sea Leach. *Tranſlated from the* French, *by Mr.* John Martyn, *F. R. S.*

A Deſcription of a new Family of Plants, which I name Oxyoïdes.

THE *Oxyoïdes* is a Family of Plants, whoſe Flower and Fruit are altogether like thoſe of the *Oxys*; that is, the Flower is compleat, regular, polypetalous and hermaphrodite; containing the *Ovary*, which afterwards becomes, as in the *Oxys*, a five-cornered Fruit, divided into five Cells, filled with ſmall Seeds; each of which is covered by a Membrane, like a Hood, which opens, when ripe; and by an elaſtic Motion, makes the Seed leap out.

The true Characters therefore which ought to diſtinguiſh this Family from the *Oxys*, are, that the Leaves are diſpoſed by Pairs along a Rib, without being terminated by an odd one, which makes them entirely reſemble thoſe of the *Tamarind*. That theſe Leaves are all gathered together, in an Umbel, on the Top of a naked Stalk: That they are not in the leaſt Degree acid, and that they ſhew as great

a

a Senſibility, on being touched, as the Species of *Mimoſa*.

The Species of this *Genus* are,

I. *Oxyoïdes Javanica, ſenſitiva, caule rubeſcente, villoſo, flore majore.* Tab. II. Fig. I.

II. *Oxyoïdes Malabarica, ſenſitiva, caule viridi, glabro, flore majore.* Tab. II. Fig. 2.

Oxalis sensit. Linn.

Deſcription of the firſt Species.

It is a Plant which grows uſually to the Height of half a Foot. It is compoſed of a naked Stalk, of Ribs of Leaves, and of Pedicles of Flowers. Each of theſe Parts is of equal Length, and uſually three Inches, when they are at their full Growth; and the whole is diſpoſed in an Umbel.

The Root, which is almoſt as long as the Stalk, runs ſtreight down, and ſometimes obliquely into the Ground. It grows taper from its Neck, which is of the ſame Thickneſs with the Stalk. It is ſet with ſmall Fibres, a little waved and white, and giving Riſe to other pretty ſhort Filaments. The whole Root is whitiſh.

The Stalk, which (as I ſaid before) is uſually three Inches high, ariſes ſometimes ſtreight, and ſometimes crooked; ſometimes wrinkled, and ſometimes plain throughout its whole Length, pretty downy, or rather hairy, and always reddiſh in ſome Places. It is from a Line and a half to two Lines thick towards the Top, and uſually ſomething leſs towards the Bottom. This Stalk, which forms a kind of Button, or little Head at the Top, gives Riſe at that Place to all the other Parts

of

of the Plant; that is, to the Ribs of the Leaves, and the Pedicles of the Flowers; which makes the whole Tuft reſemble an Umbel.

The Ribs of the Leaves, which grow from the Top of this Stalk, go on encreaſing till they equal the Length of the Stalk. They are about the Thickneſs of the treble String of a Violin, and equal throughout their whole Length. They are a little downy, after the ſame manner with the Stalk.

The Leaves, which grow by Pairs, occupy two thirds of the Rib; that Part which is next the Stalk being naked. The firſt Pair of Leaves is the leaſt, and the laſt Pair always the largeſt. Theſe are commonly half an Inch long, and the ſmalleſt are not above half the Size of the largeſt. Theſe Leaves grow ſo near the Rib, that they ſeem to have no Tail. Their Baſe is always the broadeſt Part of the whole Rib, and always parallel to the Rib: The reſt of the Leaf bends itſelf a little forwards. The Middle of their Length is uſually their narroweſt Part, and from thence they are gradually enlarged, and rounded at their Extremities. The Baſes of all the Pairs are almoſt of the ſame Bigneſs, except the laſt, which has the Breadth on one Side only of the little Nerve, which traverſes the Leaf, to avoid incommoding itſelf with its Neighbour; but to make Amends, the Leaves of this Pair are broader than the others, a little below their Extremities, eſpecially outwards. They are all traverſed lengthwiſe by a fine Nerve, or Thread, always bent like the Leaf on the Side of the laſt Pair. They are of a lively Green on the Inſide, and a little whitiſh on the Outſide. Their Plain is garniſhed with a great Number of very ſlender Threads,

Threads, almoſt imperceptible, but parallel, which grow alſo by Pairs, and are placed at acute Angles with their little common Nerve, and grow ſmaller at the Edge of their Leaf. In ſhort, their Poſition and Figure come pretty near to thoſe of the *Tamarind*. The Number is uſually from eight to ten Pairs, and they are as ſenſible on being touched, as thoſe of the Species of *Mimoſa*. They ſhut themſelves up at Sun-ſet, as it were to ſleep, after the ſame manner with the Leaves of the *Tamarind*. The Ribs are in Number from two to three Dozen; and the Pedicles of the Flowers are about a fourth Part fewer in Number: Both the one and the other appear of different Lengths, becauſe the ſhorteſt are the youngeſt, but at laſt they uſually grow to almoſt the ſame Length with the firſt. The opening of the Leaves is performed almoſt after the ſame manner with that of the Top of the Spikes of the Species of *Heliotropium*, unrolling like the Tail of a *Scorpion*. The Ribs and the Pedicles are a little hairy, as well as the Stalk. The Pedicles are of the ſame Thickneſs with the Ribs.

The Flower, though it ſeems to be monopetalous, is not ſo, any more than the Species of *Oxys*, which ſeem to be ſo too: Otherwiſe the Principles of Monſ. *Vaillant* would be falſe, who has laid it down as a Rule, that in all monopetalous Flowers the Chives grow from the Sides of the Flower, and that thoſe which grow from the Baſe of the Embryon, or rather from the Ovary, are always polypetalous. In ſhort, if we examine them nicely, which no one has done till now, we may obſerve, that theſe Flowers have no *Anus* at the Baſe, but that the Petals, which are always five in Number,

Number, have their Baſes ſeparated very diſtinctly one from another; and though they are reunited about the Middle, which makes them look as if they were of one Piece, yet they may be ſeparated without tearing. *Tab.* II. *Fig.* 3.

The Petals of our *Oxyoïdes* are equal, they are from three Lines to three and a half long, and towards the Extremity about a third Part as broad as they are long. They are lightly cut in like a Heart at their Extremities. They are of a Lemon Colour, paler or deeper, according to the Moiſture or Heat of the Seaſon. Each of them has a ſmall Streak running through their Middle Lengthwiſe. They are covered by their Empalement about two Thirds of their Height, and from thence they open in Form of a Bell. They are very tender, and laſt but the Space of one Morning.

The Empalement is one leaved: It is two Lines high, and the half of this Height makes the Thickneſs of its Baſe. It divides a little below the Top into five Lobes, very ſharp at their Extremities. It is pale-green; it is regular, and a little hairy.

The Chives grow from the Baſe of the Embryon, being twice the Number of the Petals, five of them being higher than the other five. The higheſt reach up to about the Middle of the Petals. Their Summits are of the ſame Colour with the Petals, and the Chives of the ſame with the Empalement, or a little brighter.

The Ovary is very ſmall and round, but a little furrowed into five Ribs, the Diameter of which is about one Third, or almoſt half a Line. It is crowned by five Teeth, which form the Body of the Stile.

This Ovary afterwards becomes a dry Fruit, of an oval Form, ſtarred with five Furrows, of which the leaſt Diameter is about one and a half or two Lines. This Fruit is divided into five Cells, and opens at the Top when ripe, and then expands itſelf by little and little to its very Baſe, and diſcloſes ſmall, round Seeds, lodged four together in each Cell. They are each of them covered with a little Hood, or very fine Membrane, which on the Encreaſe of the Bulk of the Seed, opens itſelf with Violence, and throws it on the Ground. The Colour of the Seed pretty nearly reſembles that of the Seed of *Pſyllium*.

Each Pedicle, during the Time of its Encreaſe, continually puts forth new Buds, and new Flowers, in the ſame manner as the Stalk continually puts forth at the Top new Leaves and new Pedicles. The Number of theſe Buds is uſually five or ſix at the Top of each Pedicle, enlarged into a Head. Theſe Buds grow, encreaſe and expand themſelves one after another, which is the Cauſe that this Plant, when once it begins to flower, puts forth new Flowers every Morning, which are quite vaniſhed in the Afternoon. The little Bunches of Buds, each of which adorns a large Pedicle, are encompaſſed with little Points, which compoſe a kind of common Empalement. In ſhort, the little Pedicle, which is proper to each Flower, is ſlender, and a full Line long, ſo that its Length is equal to the Diameter of the Empalement.

The Diameter of the Flower, when it is moſt expanded, is four Lines.

The Petals make the Empalement expand itſelf a little: but when the Flower is faded, the Lobes of the

the Empalement draw together, and form a pyramidal Body; but when the Ovary grows bigger, and becomes the Fruit, the Lobes of the Empalement expand again, without changing their Shape; becauſe the Body of this Empalement encreaſes its Diameter by the Effort which the Fruit makes within it.

REMARKS.

This Plant is very ſenſible of the leaſt Cold: It loves warm and moiſt Places. It is found in the Iſland of *Java*, and probably in the other Iſlands of the *Sonde* and the *Moluccas*. When one touches its Leaves, they cloſe immediately, and open again by little and little. The more they are warmed by the Sun, whilſt their Soil is moiſt, the more impetuouſly they cloſe againſt one another. The *Portugueſe Indians* call it *Dormidera*, becauſe, on being touched, it ſeems to ſleep, by ſhutting up its Leaves; or elſe, becauſe ſome among them think it procures Sleep by being put under the Ear, as I have ſeen practiſed; but I cannot aſcribe this ſoporifick Quality to it, any more than I can recommend the hanging of *Miſletoe of the Oak* about the Neck for the Epilepſy. The Leaves of this Species of *Oxyoïdes* have no Acidity in their Taſte, and give but a faint Tincture of Red to the blue Paper.

I thought this Plant curious and rare enough to be communicated to the curious *Engliſh* Botaniſts. I had the Pleaſure to ſee a little while ago, in Dr. *Blair*, that the Flower of the *Oxys* was pentapetalous.

The Remark of Mr. *John Martyn*, F. R. S.

We are obliged to M. Garcin *for his curious Deſcription of this Plant, by which its Genus is determined. It is however by no means a new Species, having been deſcribed long ago by* Acoſta, *and other Authors, under the Name of* Herba viva. *I have ſeen a fair Specimen of it in Sir* Hans Sloane's Hortus Siccus, *with which M.* Garcin's *Figure agrees very exactly. It was the firſt ſenſitive Plant known in* Europe, *and very different from thoſe which are now brought from* America, *and cultivated in our Gardens under that Name.*

The Flower of the Oxyoïdes, *Tab.* II. *Fig.* 3.

1. The Empalement.
2. The Flower, the Petals of which are joined together.
3. A Petal apart.

Remarks on the Family of Plants named Muſa.

Almoſt all the Writers of Botany have looked on this Family as a Tree, on account of its Bigneſs, though it is tender, ſpungy, membranous and ſucculent, not at all hard or woody. Its Stalk is ſlender and ſupple, not able to keep itſelf upright, without a great Number of thick, membranous Sheaths, which cloath its whole Bulk, and defend it from the Injuries of the Weather. Beſides, this Plant being annual bears Fruit but once, and then by Degrees periſhes.

The

The Trees on the other Side, which are ligneous, hard and perennial, bear Fruit ſeveral times. The Bigneſs then of a Plant does not ſeem to be a Character ſufficient to diſtinguiſh a real Tree from a Plant that is not one.

Again, the ſame Botaniſts have placed the *Muſa* in the *Palmaceous* Claſs, which are all Trees, perhaps on account of this Plant's having but one Stalk, without any Branches; and becauſe the great Leaves at the Top of it divide, when they grow old, in ſuch a manner as to reſemble in ſome Degree a Sort of *Palm*.

Having had an Opportunity in the *Indies* to conſider this Plant better, I ſoon found that it juſtly belonged to the *Liliaceous* Tribe. It is known that the *Liliaceous* Plants have ſeveral Characters, which diſtinguiſh them very well. Their Roots are either bulbous, tuberous, or conſiſting of thick, fleſhy Fibres: Their Leaves involve the Stalk, more or leſs at their Baſes. The Subſtance of their Flowers is filled with ſilver Spangles; and laſtly, their Fruits are always divided into three Cells. The *Muſa* has all theſe Characters. Father *Labat* ſays in his Travels, that the Root of this Plant is a thick Bulb, round and maſſy, emitting Fibres. *Marcgrave*, who has given a full Deſcription of this Plant under the Name of *Pacoeira*, has obſerved, that, at its firſt appearance, it ſends forth two or three Leaves, rolled up like a Horn, which unroll themſelves, and grow after the Manner of the *Cannacorus*. And, according to my Obſervation, the Fruit in all its Species, is conſtantly divided into three Cells, which is ſufficient to ſhew, that it is a true *Liliaceous* Plant.

As

As *Marcgrave*, and the Authors of the *Hortus Malabaricus* have largely deſcribed this Plant, I ſhall content myſelf with only giving a Definition of this *Genus*, to make it better known.

The *Muſa* is a *Liliaceous* Plant, with a monopetalous, irregular Flower, incompleat and hermaphrodite, compoſed of a Tube, which is filled with the Ovary, and a Pavilion divided into ſeveral Lobes, and forming a kind of Mouth. The Ovary, which adheres ſtrongly to the Tube, is triangular, and crowned with five Chives, which grow from the Sides of the Flower; it has alſo a Stile, which is terminated by a little Head. It afterwards becomes a ſoft, angular, long, crooked Fruit, ſomething like a *Cucumber*. This Fruit, when ripe, is fleſhy, and divided into three Cells, filled with a mucilaginous Pulp; under which the Seed is placed along a *Placenta*, which ſerves as an *Axis* to the Fruit.

This Seed is ſmall, round, edged with an almoſt imperceptible Leaf. The Flowers grow at the End of the Stalk, in Knots diſpoſed in a Spike. Each Knot is loaded with two Rows of Flowers, covered with a membranous, hollow, thick, oval Covering, which ſerves them for a common Empalement. In the *Hortus Malabaricus* there are three Plates, which give a good Repreſentation of the Plant, its Flower, and its Fruit; but I have obſerved three Defects in them: 1. That the Flower is not repreſented in its moſt perfect State, but almoſt withered, and ſo its Pavilion too much cleft, which makes the Flower ſeem tetrapetalous; for the Flowers of theſe Plants divide when they are old, as well as the Leaves. 2. That the three

Cells

Cells are not ſhewn diſtinctly, in the tranſverſe Section of the Fruit. 3. That the Seed is not repreſented at all.

This *Genus*, or Family, comprehends twenty or twenty-five Species, known to the *Indians*, the Differences of which are uſually taken from their Fruits. This Plant does not periſh before it has ripened its Fruit, whence it might laſt longer in a temperate Climate, cool enough to retard its Fruit.

The Bark of the Fruit is formed of the Tube of the Flower; and the Lobes dry away during the growth of the Fruit.

The Fruit of the Muſa *repreſented entire, Tab.* II. *Fig.* 4.

1. The ſame half ſtripped of its Bark.
2. Cut through the Middle.
3. Cut tranſverſly, diſtinguiſhing the three Cells and the Seeds.
4. Another Species of *Muſa* cut tranſverſly, repreſented in the *Hortus Malabaricus*, but having the Cells better diſtinguiſhed here. The ſix black Points are the Seed.

Hirudinella Marina, or *Sea-Leach*.

Having obſerved on the Sea a little Inſect ſhaped like a ſmall Worm, which I found in the Stomach of a *Bonite*, where it was ſtrongly faſtened, I was deſirous to examine it with regard to three Things, which excited my Admiration. 1. Its Shape. 2. The Place

of

of its Abode. 3, and laſtly, The Mechaniſm of its Reſt and Motion.

Its Shape, which was a Novelty to me, and which I ſuſpected no one had yet obſerved, came very near that of a *Leach*; it had all the Motions of that Animal, together with ſome of its own. The *Figure* A repreſents this Inſect in its natural Bigneſs, and according to its moſt conſtant Dimenſions; wherefore I ſhall not ſtay to make ſo particular a Detail of them. I ſhall content my ſelf with obſerving in general, that its Body is round throughout its whole Length almoſt, but a little flatted towards it Belly B; ſo that its Circumference, taken according to its Thickneſs, is almoſt elliptick. It is adorned all along with little circular Furrows parallel to each other, and very cloſe together, but ſo fine, that one can ſcarce perceive them without a Microſcope. It is of a greyiſh Colour, and its Body is a little tranſparent. One ſees on its Back, as well as underneath, two black Lines, which begin by an acute Angle towards the Neck, and running through the whole Length of the Body, ſeem to be terminated towards the *Anus*. Theſe Lines are not upon the Skin, as one might imagine at firſt Sight, without ſufficient Attention; they are Tubes, or Bowels, which ſerve for Nutrition or Chylification, which appear through the Integuments. I ſhall divide the Length of this little *Leach* into two Parts, diſtinguiſhed by the Center of a little Protuberance C, which is under its Belly, and is a muſcular Body, in Form of a ſpherical Bladder. Theſe two Parts of the Body are in the Proportion of Four to Three. I ſhall call them the fore Part and the hind Part. This Diſtinction is ne-

ceſſary, as well with regard to the different Motions of theſe two Parts, as to this Protuberance, which ſeparates them at their Beginning. This little Protuberance, when it is in its greateſt Extenſion that the Animal can give it, is of the ſame Form with a little ſpherical Air-Pump, and has all the ſame Properties, as I ſhall explain by and by. Its Situation is under the Body, and its Diameter is ſuch as appears in the Figure. I know not to what I can compare this Part better than to the Cup of an Acorn, with the Mouth a little contracted. The Head E, which makes the ſmalleſt End of this Worm, repreſents no Part worthy of Obſervation, except a hollow Body underneath, of a conical, or almoſt hemiſpherical Figure, which ſeems to ſerve it for a Mouth to ſuck, as well as to faſten itſelf on the various Bodies which come in its Way, after the manner of the other *Leaches*.

The Belly B is of a dark Colour, becauſe ſeveral Bowels, which are contained in it, are filled with a thick, black Liquor, which makes it look as if the Skin was of that Colour. The fore Part C E is variouſly ſhaped, according to its different Motions; ſometimes it prolongs itſelf, and then it becomes ſlender, the Diminution being made by Degrees up to the Head; and ſometimes it contracts itſelf, and then the Thickneſs encreaſing, it becomes all of an equal Bigneſs. The hinder Part C B does not change its Figure, becauſe it moves but ſlowly, and very ſeldom. The Motion of the fore Part is of three Sorts; Prolongation, Contraction, and the making itſelf round on all Sides. The Protuberance alſo is endued with two Motions, Extenſion and Undulation, which is made

from the Center to the Circumference. When this Inſect ſtops itſelf any where, it holds ſtrongly by means of this Protuberance. Before it applies it, it ſhortens it, by withdrawing the Edges, or the Circumference towards its Centre; and after it has applied the Orifice of its Protuberance upon the Surface of any Body, it lifts up a little the Center, or Bottom, towards its own Body; afterwards it ſwells it, and ſtretches it on all Sides, according to all its Dimenſions. This Protuberance thus applied, ſtretched and void of Air, makes that which endeavours to enter, preſs it externally on all Sides, and hold it ſo faſt, that it is above the Strength of the Animal to ſeparate it from it's Place where it is applied. This Animal being thus faſtened, and detained by it's Protuberance, it's fore Part is always in Motion, whilſt its hinder Part remains almoſt immoveable. It ſtretches it's Head ſometimes to the Right Hand, ſometimes to the Left, by lengthening and ſhortening its fore Part, which bends and ſtreightens itſelf very frequently. I have marked the Extent of all theſe Motions by prickt Circles of different Bigneſſes, all which touch one another at one Point of their Circumference, at the Center of the Protuberance, which is as it were the Beginning and fixed Point of all theſe Motions. Theſe Circles thus diſpoſed are excentric, contained one within the other. It is by theſe different Motions that this Inſect performs the two Functions which are neceſſary to it. 1. To find the moſt convenient Way when it has a Mind to change its Place. 2. To diſcover the moſt proper Place, either upon or within the Body of the *Fiſh*, where it finds itſelf faſtened, to ſuck the Blood,

or

or any other Juice proper for its Nouriſhment. In fine, when this little Animal deſires to change its Place, it makes uſe of its Protuberance and its Pump, which is the little Hollow under its Head, and ſeems to ſerve it for a Mouth: It applies this Part to the Place D, whither it would remove its Body, and after being prolonged by it's fore Part to reach the Place, where this Application ſhould be made, it draws its Protuberance and Pump together, by bending its fore Part circularly, after the Manner of ſome *Caterpillars*. Its Protuberance being applied, it looſens its Pump, and prolonging itſelf, applies it to another Place more forward: The Pump being faſtened, it bends itſelf circularly again to bring the Protuberance up to it, and apply it as before. By this we ſee that the Worm prolongs itſelf to apply its Pump, and contracts itſelf to do the ſame with it's Protuberance. Thus theſe Motions and Applications are made ſucceſſively, and as often as there is Occaſion. The hinder Part faſtens itſelf to nothing, but is always drawn by the Part which goes before it.

I found this Worm in the empty Stomach of a Fiſh, called by the *Portugueze*, *Bonite*: It was faſtened by its Protuberance upon one of the Folds of the inner Membrane of this *Viſcus*. This little *Leach* made a pretty deal of Reſiſtance when one endeavoured to pluck it away.

I ſhall add to this Deſcription ſome Reflexions and Conjectures, formed on the *Phænomena* which I have obſerved in this Inſect. I have obſerved, 1. That this little Animal did not live above two Hours after it was taken out of the Place where I found it. 2. That it

grew languid as ſoon as it was expoſed to the Air, and recovered ſome Vivacity as ſoon as it was put into a little Sea-water. 3. That, as ſoon as it was put in the Water, it ſent out from its Mouth a little green, almoſt imperceptible Thread, which kept itſelf ſuſpended in the Water, and was about as long as its Body, and was as fine as the fineſt Thread of a Spider's Web: After this Thread was put forth, it emitted alſo from the ſame Place ſome little Bubbles of Air. 4. That the Body of this Worm decreaſed in Bulk by little and little as long as it was alive, and that, after its Death, this Diminution either ceaſed, or became leſs ſenſible. 5. That having cut its Belly through with a Pair of Sciſſars, as ſoon as it was dead, and ſqueezed it, there came out a black, thick Liquor.

From theſe Facts we can draw but very ſlender Conſequences. It is certain that this Inſect cannot live out of the Water; ſo that one cannot imagine it could live in the Stomach of any Land-Animals, unleſs they came near the Nature of the Amphibious; for the Worms which grow upon, or within the Bodies of Animals, ought to be of the ſame Nature with them, with Regard to the Elements in which they live. Our Worm ſeems to be incapable of living any where but in the Bodies of Fiſh, ſeeing it kept alive but a very little Time in the Sea-water, in which I put it, having been expoſed to the Air but one Moment at two different Times; which was not ſufficient to alter its Parts, and cauſe its ſudden Death. The almoſt immediate Diminution of its Bulk in the Water is another Mark that it cannot live in the Sea out of the Body of the ſame Fiſh; for if the Water,

which

which was more natural to it than the Air, was injurious to it, much more would the Air, to which I expoſed it, have been prejudicial. The fine Fibre which it put forth, and the Decreaſe of its Bigneſs, were Signs that it ſuffered ſome Uneaſineſs. Laſtly, The black and thickiſh Juice, which came out of its Entrails, could be nothing but ſome half coagulated Blood, which it had ſucked in the Stomach of the Fiſh. Its Pump, which it uſes after the ſame Manner with *Leaches*, is a ſtrong Proof that this Inſect cannot take its Nouriſhment by any other Power than that of Suction. Its reſiding in the Stomach, or ſome other Part of the Body, can be for no other Reaſon but to nouriſh itſelf with the Blood, or ſome other Juice of the Animal.

As the *Bonite* is a Fiſh of Prey, living on other ſmaller Fiſhes, it is probable that this little *Leach* uſually faſtens itſelf on thoſe which come into the Stomach, and that it lives on their Blood.

The Stomach, in which I found it, was quite empty, ſo that it was probably as hungry as the *Bonite* could be; for this Fiſh is not eaſy to be catched but when hungry. However, it was the firſt Time I found it ſo very empty, though I have ſeen a great Number opened.

One may conjecture, when the Stomach of the *Bonite* is empty, and this *Leach* is in it, that it being almoſt ſtarved, faſtens its Pump to the Membrane of the Stomach, to ſuck Nouriſhment from it; and if ſo, it muſt cauſe a painful Senſation of Hunger in the Fiſh.

Laſtly, It might have happened that this little *Leach* came out of the Body of ſome ſmall Fiſh into that of the *Bonite*, which had ſwallowed it. I made this Obſervation the 28th of *July*, 1724, in a Voyage from *Batavia* to *Bengal*.

Explanation of the Figure Tab. I. *Fig.* 2.

A, The Body, in its natural Bigneſs.
B, The Belly, through which appear ſome black Lines, which are its Entrails.
C, The Protuberance, with which it faſtens itſelf.
D, The Places where it places the Pump and Protuberance, when it moves along.
E, The Head, under which is the Pump.
The pricked Circles are to mark the Extent of the Motions of its Head and Belly.

III. Typus Eclipſeos Solaris obſervatæ Julii 15, S. N. 4, S. V. Anno 1730. Witebergæ Saxonum, à Joh. Frider. Weidler, J. U. D. Mathem. Prof. Ordin. Reg. Soc. Scientiar. Pruſſ. Sodali.

Tempus Ver. antem. H.	′	″	*Phaſes Ecliptic æ.* *Digit.*	*Min.*
3	56	0	Sol oritur poſt Nubes.	
	59	0	5 & paulo plus Sol latet poſt Nubes.	
				4 10

H.	′	″	Dig.	Min.
4	10	30	6	55
	26	0	6	30
	33	0	6	0
	38	0	5	30
	43	30	5	0
	47	0	4	30
	50	15	4	0
	53	30	3	30
	57	0	3	0
5	3	30	2	0
	7	0	1	30
	10	30	1	0
	13	0	0	30
	15	30	Finis.	

ANNOTAT.

I. Sol oriens figuram orbis monſtrat ellipticam: diameter verticalis duobus digitis ſive ſexta ſui parte contractior apparet horizontali.

II. Memorabilis erat conſpectus orbis Lunæ aſpero margine præditi, quoad partem quæ in occaſum ſpectabat. Diſtincte enim cernabatur H. 4. M. 3. Vallis $\frac{1}{100}$ diam. Lunæ profunda & $\frac{1}{12}$ ejuſdem diam. circiter longa. In progreſſu eclipſeos aſperitas limbi Lunæ minuebatur, & adhærente eidem faſcia cœrulea abſcondebatur. Hæc enim faſcia ſenſim ſole altius ſurgente dilatabatur. Tum præter colorem cœruleum etiam puniceus Lunæ proprius incumbens in oculos incurrebat, & circa finem deliquii faſciæ coloratæ ſpiſſitudo

trigeſimæ

trigeſimæ ſextæ parti diametri Lunaris prope par videbatur.

III. Præterea juxta Lunaris diſci marginem coloratum perpetua Luminis ſolaris commotio notata eſt.

IV. Obſervatio ejuſdem Defectûs Solis habita Patavii, ab J. Poleno.

ORIENTE Sole, Nubes tenues Finitorem quaſi cingebant: quibus deinde evaneſcentibus, aer tantillum nebuloſus fuit, ut maculæ ſolares haud ſatis diſtincte apparerent.

Digiti Obſcur.	*Temp. Ver.* H.	′	″	*July* 14. 1730. *S. N.*
4	16	46	12	
3½	16	48	7	
3	16	50	36	
2	16	57	24	
1	17	1	20	
½	17	3	29	
Finis totius Obſcur.	17	6	8	

V. *An*

Tab. III.

The year Letters.	The hour Letters.	(1)	
1. 甲 Kia.	1 子 Tse.	甲 Kia.	黃帝
2. 乙 y.	2 丑 Tcheou.	子 Tse.	
3. 丙 Ping.	3 寅 yn.	(2)	甲
4. 丁 Ting.	4 卯 mao.	乙 y.	乙
5. 戊 Uou.	5. 辰 Chin.	卯 mao.	鬪逢
6 己 Ki.	6 巳 Se.	(3)	
7. 庚 Keng.	7. 午 ou.	始 Chi	
8. 辛 Sin.	8. 未 Wei.	皇 hoang.	施
9. 壬 Gin.	9 申 Chin.	帝 Ti	蒙
10. 癸 Kuei.	10. 酉 yeou	(4)	
	11. 戌 Sio.	庚 Keng.	丙
	12. 亥 hai.	辰 Chin.	

(13)
生物之初
其本原昔
芒子子者
黃物之所
以始也

(5)
黃 hoang.
帝 Ti

(6)
甲 Kia.

(7)
乙 y.

(8)
閧 o.
逢 Fong.

(9)
旃 Tchcou.
蒙 Mong.

(10)
丙 Ping.

(11)
彔 Jeou.
兆 Tchao.

(12)
子 Tse.
午 ou.

(14)
囷 Kouen.
敦 Tun.

(15)
敦 Tun.
牂 Tsang.

(16)
羊 yang.

(17)
丩 Tsang.

(18)
午 ou.

(19)
丙 Ping
辰 Chin.

(20)
丁 Ting.
亥 hai.

(21)
戊 Uou.
子 Tse.

(22)
甲 Kia.
申 Chin.

(23)
元 yuen.

(24)
癸 quei.
酉 yeou.

(25)
玄 hiuen.

(26)
天 Cœli.
子 filius.

(27)
聖 Ching.
祖 Tsou.
仁 gin.
皇 hoang.
帝 Ti.

(28)
胤 yn.
稙 Tchin.

(29)
涌 yong.
正 Tching.

(*)
自 Tse.
à se.
王 Wang.
Regnans.

Tab. III.

The year Letters.			The hour Lett		
1.	甲	Kia.	1	子	Tsc.
2.	乙	y.	2	丑	Tcheou
3.	丙	Ping.	3	寅	yn.
4.	丁	Ting.	4	卯	mao.
5.	戊	Uou.	5.	辰	Chin.
6	巳	Ki.	6	巳	Se.
7.	庚	Keng.	7.	午	ou.
8.	辛	Sin.	8.	未	Wei.
9.	壬	Gin.	9	申	Chin.
10.	癸	Kuei.	10.	酉	yeou
			11.	戌	Sio.
			12.	亥	hai.

V. *An Explanation of the new Chronological Table of the* CHINESE HISTORY, *tranſlated into* Latin *from the Original* Chineſe*, *by Father* Johannes Franciſcus Foucquet, *Soc. Jeſ. Biſhop of* Eleutheropolis, *and publiſhed at* Rome *in the Year* 1730. *Collected from two Accounts thereof, written in* French, *one ſent from* Rome *by Sir* Tho. Dereham, *Bar^t. to the Royal Society, the other ſent from Father* Foucquet *to Father* Euſtache Guillemeau, *a* Barnabite *at* Paris, *and by him tranſmitted to Sir* Hans Sloane, *Bar^t. Pr. R. S.*

THERE have been ſpread in *Europe* divers Opinions concerning the *Chineſe* Antiquity, which are very falſe, nay ſome very abſurd. I place in the firſt Rank of theſe falſe and abſurd Opinions that which traces back the Origin of the *Chineſe* Nation beyond our Account of the Creation of the World; likewiſe others which would fain place the Beginnings of the *Chineſe* Empire before the Deluge. Such *Chimeras* deſerve not the Pains of refuting. They are equally repugnant to good Senſe, the Rules of Criticiſm, and to Religion.

There are ſome more moderate Opinions, which bring nearer to us the Beginnings of the *Chineſe* Monarchy: theſe may be reduced to three.

* *One of the Original* Chineſe *Tables printed at* Canton, *was preſented to the Society by Sir* Tho. Dereham, *and is now repoſited in their Library.*

The firſt places theſe Beginnings under one *Fou hi*, whom it makes reign 2952 Years before *Jeſus Chriſt*.

The ſecond places them under one *Hoang Ti*, 2697 Years before the vulgar Æra.

The third in fine puts them under one *Yao*, 2357 Years before the Birth of our Saviour.

This *Fou hi*, this *Hoang Ti*, and this *Yao*, who are ſuppoſed to have been ſo many *Chineſe* Princes, are myſterious Names of heroick Perſons, who never were in *China*: this is elſewhere demonſtrated. Wherefore theſe Opinions, though they appear leſs fabulous, are not leſs remote from Truth.

It is manifeſt, that not one of theſe Opinions can be made agree with the vulgate Tranſlation of the Bible. Recourſe muſt be had to the Septuagint, which indeed would be no Inconveniency; ſeeing the Numbers of the Vulgate and thoſe of the Septuagint are equally current in the Church.

But to ſpeak in general, theſe various Opinions make the Epoque of the *Chineſe* Hiſtory remount higher than is true. Their Diverſity already gives room to perceive their Incertainty, and how little Solidity there is in the Foundations, whereon each of them ſtands.

The Author of certain Memoirs on *China*, that have made ſome Noiſe in the World, declaring for the Chronology, which fixes the true Epoque of the *Chineſe* Hiſtory at *Yao*, has not feared to advance, on this Chronology, theſe five Propoſitions.

1. That it is very much followed, and hath many Circumſtances to ſupport it.

2. That it is not fabulous in its Beginnings, as that of the *Romans* and *Grecians*.

3. That it is eſtabliſhed on many Obſervations of Eclipſes, which are marked therein, and are found very conformable to the Aſtronomical Calculations of the moſt learned Aſtronomers of the later Times.

4. That all the Parts of the ancient *Chineſe* Hiſtory have been writ by Authors contemporary with the Kings, whoſe Lives they have left us.

5. That *Confucius*, whoſe Authority ought to be of great Weight on account of his Probity and Virtue, never called this Chronology in Doubt, but always ſuppoſed it very true.

The Author of the Memoirs has but copied after other Writers more ancient than himſelf. A Reader who has never been out of *Europe*, and ſees thoſe Things affirmed with ſo much Confidence, thinks there is no Reaſon to doubt of them. Thus has the Fable been introduced without Oppoſition, by Degrees it gained the Aſcendant, and is ſo eſtabliſhed at this Day, that one ſcarce dares attack it.

Nevertheleſs the following Propoſitions are indubitable, and contradictory to the five Propoſitions juſt now cited.

1. The Chronology in queſtion is made up of Parts ill linked together, and that have no Connection; and abounds with abſurd Contradictions.

2. It is entirely fabulous in its Beginnings and Progreſs; entirely fabulous in its Principles, and in the Conſequences drawn from thence.

3. It is not built on any Obſervation of Eclipſes: The Eclipſes marked therein, and the other Aſtronomical Characters by which the Author would fain eſtabliſh it, are contradicted by the Tables and Calculations of the moſt learned Aſtronomers of theſe later Times.

4. The ancient Kings, whoſe Lives he pretends to have, are eſteemed in *China* truly chimerical Men: Theſe pretended Lives have not been writ by contemporary Authors.

The Chronicle, which contains this Texture of Fictions, is the Work of a Perſon named *Se ma Tſien*, who was born 146 Years before the vulgar Æra, *viz.* more than 2000 Years after the Time wherein *Yao* is placed, who is made firſt Emperor. If ſome Authors can be quoted for Warrantees of what this *Se ma Tſien* advances, they were modern to the Time when he wrote: theſe Authors oppoſe each other: the Stile of ſome of them is infinitely obſcure; and in the Bottom *Se ma Tſien*, as he himſelf acknowledges, had nought for the principal Ground-work of his nauſeous Chronicle, but miſerable Rhapſodies collected at Hazard, or popular Traditions which he had gathered, without underſtanding them, as he rambled over ſome Provinces. This Work is in moſt Points contradicted by the *Kings* *, a Book truly ancient, and of great Authority.

5. In fine, there is nothing that is certainly of *Confucius* to ſerve as Proof for a Chronology manifeſtly imaginary. It no where appears that he had ever examined it. This Philoſopher has left nothing in Writing; for it is not worth while to reckon a ſmall Chapter of a few Lines, which is aſcribed to him without giving good Reaſons why, and is in the Front of a Book entitled, *Ta hio*, or Great Doctrine. All the reſt that goes under the Name of *Confucius*, is read in modern Treatiſes, where he is made to ſpeak; Treatiſes which appeared in the World many Ages after the Death of this

* Kang mou.

this Philoſopher, and of Conſequence Apocryphal, ſuſpected, and for the moſt Part rejected by the moſt able of the *Chineſe*, and full of Circumſtances which theſe learned Men deny, or at leaſt call in Doubt. Moreover, if theſe Treatiſes deſerve any Credit, ſome Things are found therein, even under *Confucius*'s Name, which quite overturn the chronological Syſtem of *Se ma Tſien*. Are theſe Titles to be boaſted of as Teſtimonies of *Confucius* in Favour of a Chronology, on which, there is juſt Reaſon to believe, he never ſo much as thought?

Notwithſtanding ſo many evident Proofs of a palpable Falſhood, this Chronology of *Se ma Tſien* is at this Day received in *China*. It was at firſt neglected there: but Error inſenſibly prevailed. The Multitude among the *Chineſe*, as among us, eaſily embraces the moſt groundleſs Opinions a great Name impoſes. *Se ma Tſien* had the Employ of Hiſtoriographer of the Empire: He was the only Perſon that could be followed then. He ſoothed the Nations Pride, making not only its Origin, but even the Beginnings of its Monarchy aſcend backward to very remote Antiquity. He annoblized it by a Croud of Heroes, to whom he gave Birth in its Boſom: He enriched it by an Infinity of Incidents, invented it is true, but ſuch as were deemed inſtructive and glorious to the *Chineſe* Name. After the Loſs of the Libraries burnt under *Chi hoang*, there was not more than an Age elapſed when he compoſed this Hiſtory: ſuch a Work was a ſort of Conſolation: It was regarded as a Treaſure: Men ran eagerly after a Book that ſeemed to preſent ſuch fine Things: Its Stile was pleaſing, being Laconic and ſtrong: It was read then, and in reading

reading believed without much Examination, becauſe there was Pleaſure found in giving Credit to it.

Thus did the agreeable Poiſon inſinuate itſelf: The very Learned, or thoſe who thought themſelves ſuch, were infected thereby. But *China* has its Critics as well as we: There are ſome of them clear-ſighted enough to diſcern Fictions, and firm enough not to give themſelves blindly up to the moſt propagated Errors.

Several in after Times oppoſed *Se ma Tſien*, taxed him with exceſſive Credulity, and reproached him for his monſtrous Over-ſight. Nay, ſome laying aſide his Authority, have boldly abridged the Times, and fixed the true Epoque of their Hiſtory at a ſmall Number of Centuries before *Jeſus Chriſt*. Among theſe is the Compiler of a new Chronological Table of the *Chineſe* Hiſtory, which has lately appeared here in *Latin* on a large Sheet of Paper. It is a Tranſlation publiſhed by Father *Fouquet*, *Soc. Jeſ.* the preſent Biſhop of *Eleutheropolis*, who hath lived near twenty-three Years in *China*. The *Chineſe* Original from which the Tranſlation was made, is owing to the learned *Nien hi yao*, a *Tartar*, illuſtrious by Birth and Merit, and Viceroy of *Canton* in the Year 1724*: For the *Tartars*, ſince their Conqueſt of *China*, are become well verſed in Sciences, and eſpecially in the Hiſtory of the Empire they conquered.

Yet this Gentleman is not the Author of the Chronological Syſtem he has here drawn up. He himſelf tells

* *His Father poſſeſſed the like Poſt, and in the Year* 17 2 *his Brother w* Tſong Tou *of two Provinces, a more conſiderable and more important Employ than that of Viceroy.*

tells us, he has taken it from the moſt valued hiſtorical Work in his Country *. What renders this Writer Praiſe-worthy, is his ranging his Syſtem in a beautiful Order, which gives an extream Facility of ſeeing at firſt Sight the Series of the Dynaſties, or Imperial Houſes, the Names and Succeſſion of the Emperors, the Beginning, End and Duration of each of their Reigns.

However, this is not the only Advantage of this new Table: The ancient Chronology of *China* is therein reduced to its true Beginnings. The moſt remote Epoque of this Chronology, according to *Nien hi yao*, does not ſurpaſs the firſt Year of a Prince called *Guei lie wang*, who began his Reign 424 Years before the vulgar Æra. Some there are, who think this Epoque might ſtill be brought nearer to us; not to fix there the Origin of the Nation, which, for ſtrong Reaſons, may be traced back to Time near the Deluge; but becauſe from much later Date only, doth any Certainty appear, of whatever is pretended to have befaln this famous People. † *Se ma quang* and *Tchu hi*, the two graveſt Hiſtorians *China* has produced, were of this Opinion. The firſt flouriſhed in the Year of *Chriſt* 1061, ‡ the ſecond about the End of the twelfth Century. They have both omitted whatever is before the Time of *Guei lie wang*, nor would they mention ought of it in their Hiſtories: Nay, they have not begun them till the twenty-third Year of *Guei*

* China *is now the Country of theſe* Tartars *who were born there ſince the Conqueſt, that is about ninety Years ſince.*

† Se ma wen, *or* Sema wen Kong.

‡ Sæculo 11°. vel 12°. Sæculo 13°.

Guei lie wang, ſomewhat later than *Nien hi yao*, who begins with the firſt of this Prince's Reign. It is on the Example and Authority of theſe two illuſtrious Philoſophers that *Nien hi yao* has relied in ſuppreſſing what precedes.

By fixing this Epoque at *Guei lie wang*, fabulous Times, and a thouſand Errors and Abſurdities current in *Europe* concerning three Imperial (abſolutely imaginary) Families, and reigns anterior to, but no leſs chimerical than theſe Families, are retrenched. Theſe Errors will ſoon vaniſh of their own accord; ſo that the Subject of ſo much laborious, but uſeleſs Lucubration and Study, will at length ceaſe: a worthy Motive for congratulating the learned World.

This is not all; we are ſtill particularly obliged to the ingenious *Tartar*, for having found Means to place in his Table the Cycle of ſixty Years, called *Kia Tſe*, ſo much eſteemed by the *Chineſe*, that it is as the Soul, Link and Foundation of their whole Chronology: a Point which requires Explanation.

The *Chineſe* are not acquainted with our Olympiads; but from Time out of Mind they have uſed this Period of ſixty Years, which is of as great Service at leaſt as the Olympiads, or the moſt celebrated Periods among the *Greeks*.

As we mark the Incidents of ancient Hiſtory by the Years of the Olympiads, ſo the *Chineſe* mark what has happened in their Country by the Years of this Revolution. Our Chronologers ſay, for Example, that the *Pelopeneſian* War began the firſt Year of the twenty-ſeventh Olympiad; that *Alexander* was born the firſt Year of the one hundred and ſixth. According to the *Chineſe*, the Prince under whom the

the great Wall * was finiſhed, began his Reign the fifty-ſecond Year of a Cycle, which is found to be the fourth in this chronological Table, reckoning from the Cycle of the general Epoque incluſively. This general Epoque, as has been already ſaid, is the firſt Year of *Guei lei wang* †.

Now as the Years of the Olympiads had no proper or peculiar Names, they were diſtinguiſhed only by their Order of firſt, ſecond, third and fourth: But every Year of the *Chineſe* Cycle is marked by two Letters, which make up its proper Character, and diſtinguiſh it from the other fifty-nine. Thus the firſt Year is called (1) ‡ *Kia Tſe*, and gives its Name to the whole Cycle. Thus the fifty-ſecond Year of the fourth Cycle, in which the Prince, who finiſhed the great Wall, began his Reign, is called (2) *y mao*. This Prince, after bloody Wars, became Monarch of *China*; and then abandoning himſelf to ſuch impious Pride, as the Philoſophers reproached him with, cauſed himſelf to be called (3) *Chi hoang Ti*, as much as to ſay, *the firſt Maſter, the firſt Emperor reigning of himſelf*; for this is the real Signification of theſe Characters well analyſed; and thoſe glorious Titles belong to GOD alone in the ancient Monuments. This unheard of Uſurpation happened in the twenty-ſixth Year of his Reign, which is the ſeventeenth of the fifth Cycle, and is there called (4) *Keng Chin*.

* *This great Wall juſtly paſſes for one of the Wonders of the World, beginning at the* Eaſtern Sea, *and extending to near* Thibet, *above four hundred and fifty* French *Leagues.*

† *The Method of finding this Epoque on the Table is given hereafter.*

‡ *Vid. Tab.* III. *Fig.* 1, &c.

It is thus that all the Years of the Emperors, for above two thouſand Years, have Names in Hiſtory common to them with the correſponding Years of the Cycle: and theſe Names common to both, are a Sort of Link which unites the Years of the Emperors to the Cycle, and thereby prevents Confuſion. Hence we ſee how the Cycle among the *Chineſe* is the Knot and Baſis of all their Chronology.

Here a Queſtion naturally ariſes, concerning the Signification of theſe Characteriſtics, which diſtinguiſh the Years of the Cycle and Emperors: for it muſt be pleaſing to the Reader to dive into their true Senſe.

It is to be wiſhed it were as eaſy to anſwer this Queſtion as it is natural to propoſe it: But it regards Characters ſo infinitely different from ours, that their Nature or Origin have never been well extricated; nor has there been any Principle hitherto eſtabliſhed for their Explanation. Wherefore to endeavour now to penetrate their primitive Signification, would be the ſame thing as to attempt walking without a Light in an unknown dangerous Road, in a dark Night. Yet ſince an Anſwer muſt be given, to lead the Reader by Degrees to the Knowledge of ſo new a Subject,

We muſt remark, *Firſt*, That it is not poſſible to give theſe Names any Tranſlation. *Kia Tſe* will ſtill be *Kia Tſe* in all Languages; *y mao* will ſtill be *y mao*; *Keng chin*, *Keng chin*, and ſo the other fifty-ſeven Names: and this no *European* that underſtands the *Chineſe* Tongue will contradict.

Secondly, That theſe Names are compoſed of two Sorts of Characters* very famous among the *Chineſe*, who

* *See the Characters in the Plate annexed, Tab.* III.

who get them by Heart in their Youth, and employ them on a thouſand Occaſions. Theſe of the firſt Sort are ten in Number, and are called the *Year-Letters*; theſe of the ſecond, twelve, and are named *Hour-Letters*.

Thirdly, That theſe two Sorts of Characters are combined, by repeating the ten *Year-Letters* ſix times, and the twelve *Hour-Letters* but five times; for ſix times ten, and five times twelve equally make ſixty: and from this Combination reſult ſixty Names for the ſixty Years that compoſe the Cycle.

Theſe three Points well comprehended ſuffice for the Uſe and underſtanding of the chronological Table: and the Reader would do well to ſtop here.

It may be objected by ſome, that this Erudition is unpleaſant, becauſe it enlightens not the Underſtanding; the Names remain unintelligible, and the Reader's Curioſity is not ſatisfied. But will it be more ſo, by adding what the *Chineſe* take out of their Traditions?

I paſs by the Abuſe made of theſe twenty-two Letters by judiciary Aſtrologers. It is a Subject apart that would carry one too far: Wherefore I ſhall keep within the Bounds of what the *Chineſe* hold, and give for moſt authentic.

They pretend that theſe twenty-two Letters were invented by a very ancient King, whom they name (5) *Hoang Ti*, in order to determine the Beginning, Progreſs, End, and ſucceſſive Periods of a great Year; for they have one which includes a certain Number of Ages, though its total Duration be no where diſtinctly marked.

They ſay the great Year is ſucceſſively at *Kia*, at *y*, and at *Ping*.

Now it is no eaſy Matter to determine the Extent of theſe different Parts of the great Period (for there is room to conjecture that they are unequal) how long, for Example, laſts that which commences at (6) *Kia*, that at (7) *y*, and ſo of the reſt; nay, it is perhaps impoſſible, for want of certain Principles, the Knowledge of which is entirely loſt.

When the Year was at *Kia*, which ſeems to ſignify when it began, this Point of Time, according to Tradition, is called (8) *O ſong*; when it was at *y*, this is called (9) *Tcheou Mong*; when at (10) *Ping*, the Name given to it was (11) *Jeou Tchao*.

Every one of the other nineteen Letters has in this manner a Word for its Device; but as it is plain, that all theſe Words are very ſtrange to *European* Ears, and that thoſe which remain are as obſcure and barbarous as *Kia Tſe*, *Y mao*, *Keng chin*, it is beſt to omit mentioning them.

Nevertheleſs one ſhould not eaſily believe that theſe Words are void of all Meaning, or that the Letters, whoſe Names they are, are Figures made at Hazard, or arbitrarily imagined. The Inventor of theſe Names muſt have propoſed himſelf ſome End.

It is already known in general, and is demonſtrated elſewhere, that the Characters preſerved by the *Chineſe*, but much more ancient than them, are true Hieroglyphics.

It is likewiſe known, and ſtrongly demonſtrated, that the Doctrine veiled under the Appearance of theſe Hieroglyphics, is very myſterious and ſublime: and it is

unreaſonable to regard as Nonſenſe, and reject ſuch as we underſtand not, purely becauſe we do not underſtand them.

And indeed when we cloſely examine the twenty-two Letters in queſtion, we perceive in ſeveral of them ſomewhat very myſterious, which the *Chineſe* themſelves preſent us with without underſtanding them, For Example, (12) *Tſe*, the firſt of the *Hour-Letters*, ſignifies with the *Chineſe* both the Moment of Midnight and a tender Babe juſt born (wrapt up in his Baby-Cloaths.) *Ou*, the ſeventh of the *Hour-Letters*, ſignifies the Moment of Noon, and a Man lifted on a Croſs. This Letter ſignifies Noon, according to the Primitive Meaning, which ſtill ſubſiſts without ever having been diſuſed. It alſo ſignifies a Man lifted on a Croſs, as is evident to the Eye of any Perſon, who has the firſt Tincture of the Characters. I know ſome Difficulty may be raiſed on this Point, but it ſhall be reſolved in its proper Place.

Where have this People got ſuch Ideas? They are incomprehenſible to them at preſent, and yet (it is ſtrange) they preſerve them preciouſly, and uſe their utmoſt Endeavours to find out the Senſe of them, but to no Purpoſe.

That *Tſe* ſignifies both Midnight and an Infant juſt come to the World; that *Ou* marks Noon and a Man lifted on a Croſs, are Facts cited as they are found in the *Chineſe* Vocabularies, without Comments, Conjectures, or any other of ones private Thoughts; which ſhould be the more ſurpriſing to the Reader.

It will encreaſe the Surpriſe to reflect on a *Chineſe* Axiom, the Senſe whereof is, that the Heavens opened at the Hour of *Tſe*, which, according to the foregoing Expoſition, ought to be underſtood of the Moment of Midnight.

And in order to raiſe the Admiration a Degree higher, *Tſe*, which ſignifies an Infant, is litterally and properly uſed to ſignify *Son*. Now let the Reader give Attention to the ſurpriſing Words of a *Chineſe* Writer on this Son.

" (13) The firſt Inſtant, ſays he, of the Productiꝛ on of Things, their Principle and Origin came from " the Son. The Son is the Cauſe by which all Things " had a Beginning.

When the Year is at (12) *Tſe*, that is called (14) *Kouen Tun*. This *Kouen*, in the common Acceptation, ſignifies Work, Pain, Grief. *Tun* ſignifies being reduced to great Anguiſh. The Application of theſe Words to the tender Babe, to the Son lately born, produces a Meaning, which by being too intelligible and too beautiful, raiſes Wonder.

When the Year is at *Ou*, it is called (15) *Tun Tſang*. We have ſeen that *Tun* ſignifies Anguiſh, Affliction. To have the true Signification of *Tſang*, Recourſe muſt be had to the Analyſis, as on infinite other Occaſions.

The Analyſis gives (16) *Yang*, the Emblem of a Lamb, and (17) *Tſang*, which ſignifies to divide, to pierce. Thus at the Hour of Noon, marked by (18) *ou*, that is, a Man on a Croſs, the Lamb was pierced.

If

If the Reader is ſtruck with theſe Ideas, new to him as they muſt be, let him not attribute his Surprize to the Writer hereof, ſeeing it was the Obligation of anſwering the Objection above-mentioned that urged him thereto.

But let us drop this Subject, too fruitful in Paradoxes. What has been alledged is ſufficient to verify a Word in the *Latin* Inſtructions at the Head of the Chronological Table, *viz.* that the Characters by their Combination form the Cycle, are very profound. To enter upon the Explanation of the reſt, would lead us into new Depths, the Diſcuſſion whereof would require long and critical Diſſertations. It is well the underſtanding theſe Myſteries is of no Service to the Uſe of the Table in Hand. Wherefore let us return to the Cycle itſelf, ſuch as it is at preſent in the Hands of the *Chineſe*.

This ſo uſeful Cycle, which in the printed Hiſtory is a certain Rule to fix Time, the ingenious *Tartar* has diſpoſed in his Table with ſuch Art as renders the Relation of the Years of the Cycle to the Years of the Emperors very ſenſible; whence ſpring great Advantages that are very viſible to whoever attentively conſiders the Table, and penetrates into its Arraingment.

In the Front of the Table appears a Line writ in Capital Letters, and extends Horizontally from Right to Left: This Line contains, according to the Order of their Succeſſion, the Names of twenty-one Dynaſties, or Imperial Families, who have reigned ſince four Centuries before *Jeſus Chriſt* unto this Time.

These Names placed exactly on the Lines, where are the Beginnings of the Dynasties to which they belong, are as sure Guides for easily finding them, and under the Direction whereof one comes without Difficulty to the Knowledge of the Emperors of these Imperial Families, as well as the Incidents of their Reigns.

This Cycle is placed in the Middle, in a perpendicular Line or Column, which extends from the Top to the Bottom of the Table, and is divided into sixty little Lodges or square *Area's*, every one of which answers a Year of the Cycle, and contains the Name of the Year it answers. The Angles, or empty Spaces which surround the Name in each of these Lodges, were coloured black, that the whole may the more readily strike the Reader's Eye, and be the more easily distinguished.

On the Right and Left of the Cycle thus placed are ranged twenty other Columns, divided into sixty Lodges each, in the same manner as the Cycle; and consequently equal to the Cycle to which they are parallel.

It is in the Lodges of these Columns parallel to the Cycle, that the Years of the Emperors are disposed in their natural Order for above two thousand Years. They are disposed from Top to Bottom, from the Right to the Left, after the *Chinese* Custom; but to avoid Mistake, I mean the Right and Left to the Person who reads the Table. And it is essential to remark, that the Arangement is such, that each of these Imperial Years referred to the Column of the Cycle by an horizontal Line which falls at

right

right Angles on this Column, anſwers the Year of the ſame Cycle, whoſe Name it bears in Hiſtory*.

Purſuant to this Explanation, the firſt Year of the Prince named *Guei lie wang*, at which begins the Table, whereof that is the Epoque, will be found in the firſt Column at the right Hand, pretty near the Bottom, under the Author's ſmall Preface; and oppoſite to the fifty-third Year of the Cycle called (19) *Pin chin*; becauſe in Hiſtory this firſt Year of *Guei lie wang* has the two Letters *Ping chin* for its Characteriſtic.

The Reaſon why this firſt Year of *Guei lie wang* is taken for the general Epoque of the whole Table, is, becauſe there is neither Clearneſs nor Certainty in the Hiſtory before it: But if, becauſe this firſt Year of *Guei lie wang* is taken for an Epoque, it were placed oppoſite to the firſt Year of the Cycle, it would occaſion an Anachroniſm of fifty-three Years. A capital Point, to which thoſe, who intend to uſe this Chronological Table, cannot give too much Attention.

In a Word, ſince Hiſtory has given this firſt Year of *Guei lie wang* the Name of *Pin chin*, it is not allowed to give it any other in the Table; and one is obliged to refer it therein to the Year of the Cycle that bears that Name, under the Penalty of being guilty of confounding Time, and puzzling Chronology.

It is in this Arrangement that all the Artifice of this new Table conſiſts. And this Point once well un-

 derſtood,

* *The blank Columns at the End are left to put down the future Emperors as they ſhall ſucceed.*

derſtood, is a Key which gives Entrance into all the reſt.

The firſt Year of *Guei lie wang* being placed at the fifty-third Year of the Cycle, the ſecond Year of this Prince will neceſſarily anſwer the fifty-fourth of the Cycle, the eighth of the ſame Prince the ſixtieth and laſt of the ſame Cycle; and of Conſequence the ninth of *Guei lie wang* will be the firſt of the enſuing Cycle; and ſo of the others in a continued Series of twenty-one Centuries down to the preſent Time.

As all the Columns of the Table are parallel to the Cycle, ſo they are equal to it, and contain ſixty Years, as that does. Hence flows an eaſy Method to know in a Moment the Interval of Time elapſed between any two Years whatſoever of the Table: For it is but multiplying by ſixty the Number of entire Columns between the two Years whoſe Interval is ſought, adding thereto what remains in the two Columns on the Right and Left, until you reach the two Years in queſtion. Every one knows that Multiplication by ſixty is very eaſily performed by multiplying by ſix, and adding a (o) Cypher to the Product.

By this Method a Moment's Attention will make a judicious Reader know that there are 424 Years elapſed ſince the Epoque of *Guei lie wang* to the Year wherein *Denis le Petit* places the Birth of our Saviour: For this Year has been marked on the *Latin* Table, to be as its Center, and ſerve the *European Litterati* for a fixed Point, to regulate their Calculations on. Suppoſing *Petavius*'s Doctrine true, this *Dionyſian* Æra is one Year before the vulgar Æra, which laſt ſhould be preferred as being moſt in Uſe, if we had not

not conſidered that it coincides with the firſt Year of the Emperor *Ping Ti*. And in regard to the Scantineſs of Space, it could not be engraved therein, without omitting the Name of this Emperor, which it was neceſſary to preſerve.

But if on one Hand the Epoque of *Guei lie wang* placed in the fifty-third of the Cycle, and once well comprehended, becomes a Key that opens the Knowledge of the Table, and develops its Syſtem; on the other, the Characteriſtic Names of the ſixty Years which compoſe the Cycle, do by their Connection with the Years of the Emperors determine the preciſe Time of Incidents. Hence ariſes Clearneſs and Certainty in the *Chineſe* Chronology; for theſe Characteriſtics contribute to the Diſcovery of Errors, which either the Ignorance and Neglect of Copyiſts and Printers, or the Want of Attention in Authors, often introduce into Chronology.

For Example: In the Chronological Table of the *Chineſe* Monarchy, printed at the End of the Work, whoſe Title is, *Confucius Sinarum Philoſophus*, it is ſaid, that *Chi hoang Ti* *, in the twenty-fourth Year of his Reign, built, or (to ſpeak more accurately) finiſhed the great Wall; and conſequently the burning of the Books is placed in the ſame Emperor's twenty-fifth Year. Now according to Hiſtory, the great Wall was finiſhed in the Year of the Cycle called (20) *Ting hai*, a Name that can agree only

* Vide Monarchiæ ſinicæ tabulam chronologicam, p. 24 & 25. Chi hoang Ti, anno Imperii 24° murum celeberrimum 400 & ultra leucarum extruxit contra Tartarorum eruptiones: anno 25° libros omnes præter medicos & judiciarios cremari juſſit.

(Chi *ſhould be pronounced like our* Engliſh She.)

with the thirty-third Year of this Emperor's Reign. As to the burning of the Books, it is marked in Hiſtory in the Year (21) *Vou Tſe*, which neceſſarily anſwers the thirty-fourth Year of this evil Prince.

Thus theſe Characteriſtic Names of the Years that compoſe the Cycle, are as a Touch-ſtone, that is of wonderful Service for diſtinguiſhing Truth from Falſhood, and re-eſtabliſhing Order when diſturbed.

This Cycle removed, the Years of Emperors might be very eaſily confounded, by augmenting or diminiſhing their Number.

When an Emperor is newly come to the Throne, if the firſt Year of his Reign be reckoned that, wherein his Predeceſſor died, it is placing two Years in one; becauſe according to the *Chineſe* Cuſtom the Year, wherein an Emperor ends his Reign, is wholly attributed to him, though he died in the Beginning of the firſt Month; and his Succeſſor is held to reign only from the Beginning of the enſuing Year.

Yet this Cuſtom, though very common, is not ſo univerſal, but that ſome Emperors have derogated from it. The *Tartarian* Emperor *Tchang hoang Ti*, Founder of the Dynaſty now reigning, cauſed the Year, wherein *Hoai Tſong* had murdered himſelf, to be taken for the firſt Year of his Reign, which was the ſeventeenth and laſt of this laſt Emperor of the *Mings*.

If, according to Cuſtom, this ſeventeenth and laſt Year of *Hoai Tſong* were diſtinguiſhed from the firſt of *Tchang hoang Ti*, it would be making two Years of one, which would confound Time.

Reſume the Cycle, apply it to the Years of the Emperors, and theſe Errors will appear of themſelves. You will

will ſee that the Year wherein *Hoai Tſong* died was called (22) *Kia-Chin*; that that, wherein *Tchang hoang Ti* began his Reign, was likewiſe called *Kia Chin*: therefore they are the ſame Year. If it were made two, the Miſtake would be found at firſt Sight, and ſhould be corrected.

Under the (23) *Yven* thoſe occidental *Tartars*, whoſe Domination over *China* began in the Year 1280, and ended in 1368, the Emperor *Wen Tſong* died in 1333: *Ning Tſong* his Succeſſor reigned but ſome few Months, and *Chun Ti*, who ſucceeded *Ning Tſong*, mounted the Throne towards the End of the ſame Year. Three Years may be eaſily made of this one, in order to place the three Princes juſt named. But whoever makes uſe of the Cycle need not fear the Miſtake. The Deaths of the two firſt Emperors, and the Acceſſion of the third to the Throne, are three Incidents, which Hiſtory refers to the Year of the Cycle named (24) *Quei yeou*. And this Characteriſtic Name is a Link that binds them all together, ſo that it is no longer poſſible to ſeparate them.

Theſe Examples ſuffice: It is eaſy to comprehend, that if during Interregnums or Anarchies, the Time were lengthened or abridged, or if it were confounded during Civil Wars carried on between two claſhing Families diſputing the Sovereign Power, the Application of the Cycle would ſet all right.

The Names which mark the Years of the Cycle are then a certain Rule to redreſs the Errors of unskilful Chronologers. They reſemble a Torch which gives Light in a dark or difficult Path. The Learned, who will know to ſet a juſt Value on theſe Characteriſtics,

will

will be pleaſed with them, and will perhaps prefer them for Uſe to the Conſular Reckonings, wherein are found ſo many diſcouraging Interruptions. And if Medals have ſomewhat more enticing and ſplendid in them, there is a certain Simplicity always uniform in the Continuation of the Years of the Cycle neceſſarily followed, which leads the Mind to Truth by an eaſy Road, without much Ornament, Expence or Enquiry after Monuments.

Another Property of this new Table, no leſs remarkable or uſeful than the foregoing is, that this Table lays before the Eye all the Names of the particular Epoques aſſumed by the Emperors of *China* for near two thouſand Years. For *Han uou Ti*, the firſt who took this Sort of Epoque, began his Reign one hundred and forty Years before *Jeſus Chriſt*.

No body, to the beſt of our Knowledge, has given *Europe* a ſufficient Account of the Nature of theſe Epoques, though they are very well worth explaining. The Emperors of *China* have a particular Cuſtom, little known in *Europe*, which, if Care be not taken, would infallibly ſpread Darkneſs and Confuſion over Chronology and Hiſtory. It is not allowed to pronounce the proper Name of any Emperor during his Life, which is looked on in ſome Meaſure as ineffable. This Reſpect continues even after their Deaths; for then it is not by their proper Names they are mentioned, but are conſecrated (if we may uſe the Term) by a Surname, which is a Sort of Character of Canonization. And under this Title are they received into the Burying-place of their Anceſtors, and afterwards ranked in Hiſtory. But in their Life-time, to ſupply

the Name that dare not be pronounced, they themſelves, in Imitation of *Han uou Ti* already mentioned, chooſe and determine a Term that ſerves for an Epoque to the Incidents of their Reign. This Term we call Epoque, becauſe it is from it the Years of Emperors are reckoned, and to it is referred every thing that falls out during theſe Years. Examples will make theſe Things eaſy to comprehend. The famous Emperor who died *December* 20, 1722, after a Reign of ſixty-one Years, had the Letter (24) *Hiuen* for his proper Name. During his Reign, this Letter was not to be put into any publick Memorial, Book or Writing. The Letter (23) *Yuen* was ſubſtituted in its Room, becauſe it would be a kind of Prophanation to employ for common Uſe the Name of a Prince, who ſtiled himſelf (25) *Son of Heaven*.

After his Death his fourth Son, who ſucceeded him gave him for Title of Canonization, the glorious Surname of (27) *Ching Tſou gin hoang Ti*; as much as to ſay, *the holy Anceſtor, the auguſt, good and merciful Emperor* *. It is under this Surname that he has been interred among his Anceſtors, and it is under the ſame that Hiſtory will make mention of him for the future.

Upon his aſcending the Throne after a Father who had conquered *China*, he aſſumed for the Epoque of his Years the two Letters *Kang hi*, the Senſe whereof is *Solid Peace*, or *laſting and glorious Tranquillity*. Thus becauſe in the † thirty-eighth Year of his Reign

* *This Character* Gin, *which I have tranſlated* gracious and merciful, *ſignifies* Charity: *it alſo expreſſes ſometimes* the Conjunction of all Virtues: *and it may bear that Senſe here.*

The Character Hoang (27 *) *when analyſed, is found to be compoſed of* Tſe, *which ſignifies* of himſelf, *and* Wang, *which tranſlated is* Reigning.

† *In the thirty-fifth.*

Reign he conquered by his Generals a Prince of *Tartary* named *Kaldan*, this Victory is ſaid to be gained the thirty-eighth Year of *Kang hi*, or of *the laſting and glorious Tranquillity*.

The Letters (28) *Yn Tchin* compoſe the Name of his fourth Son, who now reigns; wherefore the Uſe of theſe Letters is and will be prohibited until a new Government. As to the Title of Canonization, by which this Prince is to be recorded in Hiſtory, it will not be given him till after his Death. But upon his Acceſſion to the Crown, as he had a great Number of Brothers and Nephews, he took for Epoque of his Years the two Letters (29) *Yong Tching*, which ſignify *Direct Concord*; to give to underſtand, that if his Brothers and Nephews pay him the Reſpect and Submiſſion they owe him, he would treat them with Kindneſs.

The Empreſs his Mother died ſome few Months after he began his Reign; ſo the Death of this Princeſs will be marked in Hiſtory in the firſt Year of *Yong Tching*, or of the *Direct Concord*. Thus will all other Incidents be fixed by the Years of the *Direct Concord* in which they will happen.

It is plain from theſe Examples, that the Names of Emperors, and the Names of their Epoques are eſſentially different, and that thoſe of the Epoques comprehend very inſtructive Meanings, the underſtanding which muſt be of great Service to the clearing up of Hiſtory.

But there is great Danger leſt the Name of an Epoque be made the Name of an Emperor, which would double the Number of Emperors, ſuppoſing

even

even that each of them had taken but one Epoque during his Reign.

No *European* Writer, that we know, has faithfully given them all: But this Table preſents us with an exact and entire Series of them. And yet it is a thing much to be wiſhed for, to have a faithful Explanation of them; a Work which would engage one in a Review of the whole Hiſtory, but will be undertaken nevertheleſs, if we find room to hope, that it will not be diſagreeable to the Learned.

The Inconveniency is, that a great Number of Emperors have often changed theſe Names of Epoques. This Inconveniency is not found in the Dynaſty now reigning; but in the more ancient it is a very common Diſorder. *Han uou Ti*, the firſt that introduced the Uſe of Epoques, aſſumed, during his fifty-four Years Reign, to the Number of eleven very different Epoques. Several others have followed his Example, which cannot but cauſe a great deal of Confuſion in Hiſtory, if one happened to imagine, as it is natural enough to do, that theſe Names of Epoques are the Names of ſo many Emperors.

It was of Importance to clear up theſe Things thoroughly; this the Table does: and to avoid Miſtake, Care has been taken to have the Emperor's Names or Titles engraved in large Characters, and thoſe of the Epoques in ſmall Letters. Moreover, when an Emperor, not content with one Epoque, has taken ſeveral, Notice is given of it by a Star placed on one Side of the firſt.

In ſhort, to leave nothing conjectural, as often as a Reader conſidering this Table, ſhall find two ſeparate

Ranks of Figures oppoſite to one another in a Series of ſeveral Lodges, denoting different Numbers, he is to remember, that theſe Figures mark the Years of Emperors of two Families, which diſpute the Empire, one of which being ſoon to periſh, will give room to the other to aſcend the Throne. The Column found under the Title *San Koue*, that is to ſay, *the three Kingdoms*, is an Example hereof. This Title of three Kingdoms denotes the Time when *China* was divided into three different Parts; and the Column, on the Top of which is found that Title, in the Order of the Dynaſties is the twelfth, reckoning from the firſt at the Reader's right Hand incluſively. We ſee in the forty-third Lodge that the firſt Year of the Epoque *Tai ho* aſſumed by the Emperor *Ming Ti*, of the Family called *Guei*, anſwers to the fifth Year of the Epoque *Kien hing* aſſumed by *Heou Tchu*, Emperor of the *Han's*: the ſecond Year of the Epoque *Tai ho* anſwers to the ſixth of the Epoque *Kien hing*, and ſo of the reſt that follow. The Reaſon is, that the Empire was at that Time torn in Pieces by bloody Wars: The *Guei's* were getting the upper Hand, and the *Han's* very near their Ruin.

As to a great Number of Lodges that have but one or two Figures, without any Account of Hiſtory, they are unpleaſing Blanks, which however the *Chineſe* matter not, ſatisfied to have an exact Series of their Emperors Years in theſe Lodges. But ſuch Blanks may be filled by inſerting ſome conſiderable Incidents of Hiſtory, as ſome few have already been in the *Latin* Edition, *viz.* the building of the great Wall, the burning of the Books, the *Chriſtian* Æra, the

the Introduction of the *Chriſtian* Religion into *China*, the Appearance of a Star ſeen in the Heavens upwards of ſeventy Days *, the true Year in which our Saviour was born, *&c.* If this Addition pleaſe the Learned, it will be no difficult Matter to add ſeveral other Incidents unknown in *Europe*.

This is what occurs to be ſaid for perfectly underſtanding the new Chronological Table of the *Chineſe* Hiſtory. This Expoſition will be of Service to ſuch as think the *Latin* Inſtructions at the Head of the Table inſufficient; not that this Table has of itſelf ought that can puzzle a Perſon ever ſo little accuſtomed to this Kind of Study. The *Chineſe* Youth play with it, and ſee the Matter in queſtion at firſt Sight: But it is an Object hitherto unſeen in *Europe*; and that is ſufficient to ſtartle certain Readers, who, though Men of Senſe, frequently ſeek Myſteries, where there are none; and then Perſpicuity itſelf becomes Obſcurity. For Perſons of this Character the beſt Way would be to conſider the Table for ſome Moments with one, who has already comprehended its Uſe. A little Inſtruction by Word of Mouth is better than a thouſand Commentaries: The Eye does a great deal, but the Ear is much more efficacious for infuſing Knowledge into our Minds without Labour. When theſe two principal Senſes are united, and applied in Concert, Difficulties which looked frightful, are ſeen to vaniſh.

To conclude, it is Uſe only can make one ſufficiently ſenſible of all the Advantages of this Table.

* *The* Chineſe *ſay of this Star, that it was a Sign of Renewal in the World.*

Thoſe who have no Inclination to know what has paſſed in *China*, who read not its Hiſtory nor Accounts, who ſtudy not its Religion, Arts, Sciences, Government, nor Policy, have no Need of this Table; but whoever applies himſelf to the Study of the different Articles juſt mentioned, may be aſſured that he will draw ſuch Helps hence as Experience alone can enable him to ſet a juſt Value on. For at firſt Glance of the Eye one will ſee therein the Beginning and the End of all the Reigns, the Duration of the Dynaſties, the Succeſſion of the *Chineſe* Monarchy; and that one will therein diſcover, as in a faithful Looking-Glaſs, the Faults of Chronology diſperſed in ſeveral Authors: But the principal Advantage is, that this Table, conformably with the moſt valued Hiſtory, fixes the true Epoque of the *Chineſe* Empire to four Centuries or thereabouts before the Birth of our Saviour. By the true Epoque of the Empire underſtand not the Beginnings of the Nation, which it is credible (as we have remarked before) remount to the next Ages after the Deluge; but the Beginning of the Monarchy, which is the Time, when the Incidents that happened in this Nation, appearing grounded on certain Proofs, deſerve the Credit of learned Men. This important Point once cleared up, ought to put an End to the Diſputes of the Learned on the fabulous Antiquity of *China*. Excellent Wits, capable of greater Things, will henceforth diſdain to employ their Lucubrations in ſuch frivolous Scrutinies.

VI. *An Account of* Mr. Mark Catesby's *Eſſay towards the Natural Hiſtory of* Carolina *and the* Bahama *Iſlands, with ſome Extracts out of the firſt three Sets. By* Dr. Mortimer, *R. S. Secr.*

OUR Author propoſes in this Work to give the Figures of the Birds, Beaſts, Fiſhes, Serpents, Inſects and Plants, the greateſt Part whereof have never been deſcribed by any Author, or no good Figures given of them. He gives the Deſcription of them in *Engliſh* and *French*, with Obſervations of the Air, Soil and Water; and an Account of the Agriculture, Grain, Pulſe, Roots, and other Productions of the Country, with a Map of the ſame. The Author was near four Years in theſe Parts, where he deſigned every thing from Nature in their proper Colours: in order to make the coloured Prints almoſt equal to his Original Paintings, he engraves and colours them with his own Hand. In this ſhort Account I ſhall recite the Names of the ſeveral Animals and Plants, and as a Specimen of what is deſcribed more at large juſt hint ſome few of the remarkable Things which occur in the Deſcriptions of them.

1. He begins with the *Aquila capite albo*, the bald Eagle. This Bird lives on Fiſh.

2. *Accipiter Piſcatorius*, the Fiſhing Hawk. This alſo lives on Fiſh, which it takes by plunging into the Water. The bald Eagle commonly attends him, and

and when he ſees that an Hawk hath got a Fiſh, he compels him to let it fall, and is ſo very ſwift as ſeldom to fail catching it before it comes to the Water.

3. *Accipiter Plumbarius*, the Pigeon Hawk, ſomewhat reſembling ours, only it hath four white Lines croſs its Tail.

4. *Accipiter Cauda furcata*, the Swallow-tail Hawk.

5. *Accipiter minor*, the little Hawk.

6. *Buteo, Specie Gallo-Pavonis: ſeu Vultur Gallinæ Africanæ facie Hiſt. Jam. p.* 294. *Vol.* II. The Turkey Buzzard. This Bird feeds on Carrion, and is wonderfully ſagacious in ſmelling a Carcaſs at a very great Diſtance.

7. *Noctua Aurita minor*, the little Owl.

8. *Caprimulgus*, the Goat-ſucker, which feeds on Inſects, with a *Grillo-talpa*.

9. *Cuculus Carolinenſis* the Cuckow; with the *Caſtanea pumila Virginiana, fructu racemoſo parvo, in ſingulis capſulis echinatis, unico. D. Baniſter.* The Chinkapin.

10. *Pſittacus Paradiſi ex Cuba*, the Parrot of Paradiſe from *Cuba*; with the *Frutex Lauri folio pendulo, fructu tricocco, ſemine nigro ſplendente*, the Red-wood.

11. *Pſittacus Carol.* the *Carolina* Parrot, with the *American* Cypreſs.

12. *Monedula purpurea*, the purple Jackdaw.

13. *Sturnus niger, alis ſupernè rubentibus*, the Red-winged Starling, with the *Myrtus Brabanticæ ſimilis*,

ſimilis, Carolinenſis humilior, foliis latioribus & magis ſerratis, the broad-leafed Candle-berry Myrtle.

14. *Hortulanus Carol.* the *Carolina* Ortulan, with Rice on which it feeds.

15. *Pica Glandaria cœrulea criſtata,* the blue Jay, with the *Smilax lævis Lauri folio baccis nigris,* the Bay-leaved Smilax.

16. *Picus maximus roſtro albo,* the large white Bill'd Wood-pecker, with the *Quercus, an potius Ilex? Marilandica, folio longo anguſto ſalicis,* the Willow Oak. *Raj Hiſt.*

17. *Picus niger maximus capite rubro,* the large Red-creſted Wood-pecker, with the *Quercus ſemper virens foliis oblongis non ſinuatis. D. Baniſter,* the live Oak.

18. *Picus major alis aureis,* the Golden-winged Woodpecker; with the *Quercus caſtaneæ foliis, procera arbor Virginiana. Pluk. Alma.* the Cheſnut Oak.

19. *Picus ventre rubro,* the Red-bellied Woodpecker.

Picus medius quaſi villoſus, the hairy Woodpecker.

Quercus (forte) Marilandica, folio trifido ad Saſſafras accedente. Raj Hiſt. the Black Oak.

20. *Picus capite toto rubro,* the Red-headed Woodpecker. *Quercus folio non ſerrato in ſummitate quaſi triangulo.* the Water Oak.

Syringa baccifera, Myrti ſubrotundis foliis, floribus albis gemellis ex Provincia Floridana. Pluk. Amalth. 198. *Tab.* 444.

21. *Picus varius minor, ventre luteo,* the yellow Bellied Wood-pecker.

Picus varius minimus, the ſmall ſpotted Woodpecker.

Quercus.

Quercus alba Virginiana. Parkinſon. the White Oak.

Quercus Carolinenſis virentibus venis muricata, the White Oak with pointed Notches.

22. *Sitta capite nigro,* the Nut-hatch.

Sitta capite fuſco, the ſmall Nut-hatch.

Quercus humilior ſalicis folio breviore, the Highland Willow Oak.

23. *Palumbus Migratorius,* the Pigeon of Paſſage. Theſe come in ſuch incredible Numbers, that in ſome Places where they rooſt, which they do ſometimes upon one anothers Backs, they have broke down Branches of Oak Trees with their Weight, and leave their Dung ſome Inches thick on the Ground under them. They are ſuppoſed to come far North of the River *St. Lawrence.*

Quercus Eſculi diviſura foliis amplioribus aculeatis. Pluk. Phytograph. Tab. LIV. the Red Oak.

24. *Turtur Carolinenſis,* the Turtle of *Carolina.* They feed much on the Berries of the *Blitum Virgin.* which are Poiſon, yet theſe Birds are reckoned good Meat.

Anapodophyllon Canadenſe Morini, vid. Turnef. inſt. p. 239 the *May*-Apple.

25. *Columba capite albo. Hiſt. Jamaic. p.* 303. *Tab.* 261. *Vol.* II. the white crowned Pigeon.

Frutex cotini fere folio craſſo, in ſummitate deliquium patiente, fructu ovali cæruleo, [*vel rubro*] *oſſiculum anguloſum continente,* the Cocoa-Plumb.

26. *Turtur minimus Guttatus,* the Ground-Dove.

Zanthoxylum ſpinoſum, Lentiſci longioribus foliis, Euonimi fructu capſulari ex Inſula Jamaicenſi, D. Baniſter Phytogr. the Pellitory or Tooth-

ach

ach Tree. Its Bark is hot and aromatic, and therefore uſed for the Tooth-ach.

27. *Turdus minor, cinereo-albus non maculatus, Hiſt. Jam. p.* 306. *Tab.* 256. *Fig.* 3. the Mock-Bird. They mock or imitate the Notes of all Birds, from the humming Bird to the Eagle.

Cornus mas Virginiana, floſculis in corymbo digeſtis, perianthio tetrapetalo albo, radiatim cinctis Pluk. Almag. 120. the Dogwood Tree.

28. *Turdus Ruffus*, the Fox-coloured Thruſh.

Ceraſi ſimilis arbuſcula Mariana, pædi folio, flore albo parvo racemoſo. Pluk. Mantiſſ. 43. *Tab.* cccxxxix. the cluſtered black Cherry.

29. *Turdus pilaris, Migratorius*, the Fieldfare of *Carolina.*

Ariſtolochia Piſtolochia, ſeu Serpentaria Virg. caule nodoſo. Pluk. Almag. p. 50. *Tab.* 148. the Snake-root of *Virginia.*

30. *Turdus viſcivorus plumbeus*, the Red-legged Thruſh.

Terebinthus major Betulæ cortice, fructu triangulari, Hiſt. Jam. Vol. II. *p.* 89. *Tab.* 199. the Gum Elemy Tree.

31. *Turdus minimus*, the little Thruſh.

Agrifolium Carolinenſe, foliis dentatis, baccis rubris, the *Dahoon* Holly.

32. *Alauda gutture flavo*, the Lark.

Gramen Myloicophoron Oxyphyllon Carolinianum. Pluk. Almag. p. 137. *Tab.* 32. the Sea-ſide Oat.

33. *Alauda magna*, the large Lark.

Ornithogalum luteum parvum foliis gramineis glabris, the little yellow Star-Flower.

34. *Paſſer niger, oculis rubris,* the Towhe Bird.

Paſſer fuſca, the Cow-pen Bird.

Populus nigra, folio maximo, gemmis Balſamum odoratiſſimum fundentibus, the black Poplar of *Carolina.*

35. *Paſſerculus,* the little Sparrow.

Convolvulus Carolinenſis, anguſto ſagittato folio, flore ampliſſimo purpureo, radice craſſâ, the purple Bindweed of *Carolina.* It is reported that the *Indians* dawb themſelves over with the Juice of this Plant, and then venture to handle Rattle Snakes without any Harm.

36. *Paſſer nivalis,* the Snow Bird.

Orobanche Virg. flore pentapetalo cernuo Pluk. Almag. p. 273. *Tab.* CCIX. *Fig.* 7. Broom Rape.

37. *Paſſerculus bicolor Bahamenſis,* the *Bahama* Sparrow.

Bignonia arbor pentaphylla, flore roſeo majore, ſiliquis planis Plum. Cat.

38. *Cocothrauſtes rubra,* the red Bird, or *Virginia* Nightingal, called in *French, Le Cardinal.*

Nux Juglans alba Virg. Park. Theatr. 1414. the Hiccory Tree.

Nux Juglans Carolinenſis, fructu minimo, putamine levi, the Pig-nut.

39. *Cocothrauſtes cælurea,* the blue Groſs-Beak.

Magnolia Lauri folio, ſubtus albicante, the ſweet flowring Bay.

40. *Cocothrauſtes purpurea,* the purple Groſs-Beak.

Toxicodendron, foliis alatis, fructu purpureo, Pyri-formi ſparſo, the Poiſon Wood. This Tree diſtills a Liquid, black like Ink, which the Inhabitants ſay is Poiſon.

41. *Frin-*

41. *Fringilla purpurea*, the purple Finch.

Arbor in aqua naſcens, foliis latis acuminatis & non dentatis, fructu Eleagni minore, the Tupelo Tree.

42. *Fringilla Bahamenſis*, the *Bahama* Finch.

Arbor, Guajaci latiore folio, Bignoniæ flore cæruleo, fructu duro in duas partes diſiliente, ſeminibus alatis imbricatim poſitis, the broad-leaved *Guaicum* with blue Flowers.

43. *Carduelis Americanus*, the *American* Goldfinch.

Acacia, Abruæ foliis, triacanthos, capſula ovali unicum ſemen claudente.

44. *Fringilla tricolor*, the painted Finch. This is a moſt beautiful Bird; its Head and Neck are blue; its Back green, and the Belly red: The Hen is plain brown like a Sparrow, and ſo are the Cocks too, when hatched; and it is ſeveral Years before they attain their Colours in Perfection. The *Spaniards* call it *Mariposa pintada*, or the painted Butterfly.

45. *Linaria cærulea*, the blue Linnet.

Solanum triphyllon flore hexapetalo carneo.

46. *Garrulus Carolinenſis*, the Chatterer.

Frutex corni foliis conjugatis; floribus inſtar Anemones Stellatæ, petalis craſſis, rigidis, colore ſordide rubente; cortice aromatico. The Bark is as odoriferous as Cinnamon.

47. *Rubicula Americana cærulea*, the blue Bird. This Bird hath a red Breaſt (and therefore may be called the Robin Red-breaſt of *America*.)

Smilax non ſpinoſa humilis, folio Ariſtolochiæ, baccis rubris.

48. *Icterus ex aureo nigroque varius*, the *Baltimore* Bird. It hath its Name from being of the ſame Colour with Lord *Baltimore*'s Coat of Arms, which are yellow and black (Topaz and Diamond.)

Arbor Tulipifera Virg. tripartito aceris folio, mediâ laciniâ velut abſciſſâ. Pluk. Phytogr. Tab. 117 & 248, the Tulip Tree, ſo called, becauſe its Flowers ſomewhat reſemble a Tulip.

49. *Icterus minor*, the Baſtard *Baltimore* Bird.

Bignonia Virucu foliis; flore ſordidè albo, intus maculis purpureis & luteis aſperſo; ſiliquâ longiſſimâ & anguſtiſſimâ, the *Catalpa* Tree.

50. *Oenantha Americana pectore luteo*, the Yellow-breaſted Chat. This Bird I never ſaw in the inhabited Parts: It flies with the Legs extended behind it (like an Heron.)

Solanum triphyllon; flore hexapetalo, tribus petalis purpureis erectis, cæteris viridibus reflexis.

51. *Hirundo purpurea*, the purple Martin.

Smilax (forte) lenis, folio anguloſo hederaceo.

52. *Muſcicapa criſtata, ventre luteo*, the creſted Fly-catcher.

Smilax, Bryoniæ nigræ foliis, caule ſpinoſo, baccis nigris. The Inhabitants of *Carolina* make a Decoction of the Roots of this Plant, which they eſteem a great Cleanſer of the Blood; and the tender Shoots in the Spring they boil and eat like Aſparagus. They call it there *China*-Root.

53. *Muſ-*

53. *Muſcicapa nigreſcens*, the Black-cap Fly-catcher.

Gelſiminum, ſive Jaſminum luteum odoratum Virg. ſcandens, ſemper virens Park. Theatr. p. 1465. Though *Parkinſon* calls it *ſemper virens*, I have always ſeen it loſe its Leaves in Winter.

54. *Muſcicapa fuſca*, the little brown Fly-catcher.

Muſcicapa oculis rubris, the red Eyed Fly-catcher.

Arbor lauri folio ; floribus ex foliorum alis pentapetalis, pluribus ſtaminibus donatis.

55. *Muſcicapa coronâ rubrâ*, the Tyrant. The Courage of this little Bird is ſingular; he puts to Flight all Birds, both great and ſmall, that come near his Station: He attacks even the Eagle, by fixing on his Back, and ſo perſecutes him till he lights on ſome Tree, from whence the Eagle dares not to ſtir till the little Tyrant thinks fit to leave him. When their Young are flown, they are as peaceable as other Birds.

Cornus mas odorata, folio trifido margine plano ; Saſſafras *dicta. Pluk. Almag.* In *Virginia* they uſe a ſtrong Decoction of this Root ſometimes with Succeſs in Intermitting Fevers.

56. *Muſcicapa rubra*, the Summer red Bird.

Platanus occidentalis, the Weſtern Plane Tree.

57. *Parus criſtatus*, the creſted Tit-mouſe.

Ciſtus Virginiana, flore & odore Periclymeni D. Baniſter, the upright Honeyſuckle.

58 *Parus uropygeo luteo*, the yellow Rump.

Helleborine, Lilii folio caulem ambiente ; flore unico hexapetalo, tribus petalis longis anguſtis obſcurè purpureis, cæteris brevioribus roſeis, the Lilly-leafed Hellibore.

Apocynum ſcandens, folio cordato, flore albo. Dog's-Bane.

59. *Parus Bahamenſis*, the *Bahama* Titmouſe.

Arbor, Jaſmini floribus albis; foliis Cenchranmideæ, fructu Ovali, ſeminibus parvis nigris mucilagine involutis, the ſeven Years Apple. He knows not the Reaſon of the Name, becauſe the Fruit ripens in ſeven or eight Months Time.

60. *Parus cucullo nigro*, the hooded Titmouſe.

Arbor in Aqua naſcens, foliis latis acuminatis & dentatis, fructu Eleagni majore, the Water Tupelo.

ERRATA.

PAG. 378. l. 5. for *villoſo* read *hirſuto*. Ibid. l. 7. after *glabro* add *altiore*. P. 388. l. 6. after *Figure* A add *Tab.* I. *Fig.* 2. P. 395. l. 15. add *Vid. Tab.* I. *Fig.* 3. P. 402. at the Bottom, read 1722. P. 403. l. 25. after *twelfth Century* add a Mark, which muſt be referred to the Note at the Bottom of the Page *Saculo* 13°, theſe Notes containing the different Readings of the two Accounts, and the Explanation at the Head of the printed Table. P. 411. l. 9. after *Characters* add *which*. Ib. l. 6 from the Bottom, for *and extends*, read *which extends*. P. 415. l. 7. after 53*d* add *Year*.

ADVERTISEMENT.

THE Chronological Tables of the *Chineſe* Hiſtory, in *Latin*, are to be ſold by *W. Innys* at the Weſt End of St. *Paul's*, *N. Prevoſt* over againſt *Southampton-ſtreet* in the *Strand*, and Mr. *Hauksbee*, at the Houſe of the *Royal Society* in *Crane-Court*, *Fleet-ſtreet*.

Numb. 416.

PHILOSOPHICAL TRANSACTIONS.

Jos: Banks

FOR THE

Months of *November* and *December*, 1730.

The CONTENTS.

I. *An Account of the præternatural Delivery of a* Fœtus *at the* Anus; *communicated by Mr.* Nourſe, *one of the Aſſiſtant Surgeons to St.* Bartholomew's Hoſpital; *Demonſtrator of Anatomy at* Surgeons-Hall, *and F. R. S.*

II. *An Extract of a Letter from Mr.* William Stevenſon *to* Benj. Hoadly, *M. D. F. R. S. Containing an Account of an Obſervation of an Eclipſe of the Moon, on* July 29, 1729, *made in* Barbados *by Mr.* Stevenſon's *Brother.*

III. *The Anatomical Preparation of Vegetables, by* Albertus Seba, *F. R. S. Communicated to the Royal Society by Sir* Hans Sloane, *Bar^t. Pr. R. S. and Col. Med.* Lond. *Tranſlated from the* German, *by Mr.* Zolman, *F. R. S.*

IV. *An Account of what happened from Thunder in* Carmarthenſhire; *partly had from the Woman's Mouth that ſuffered by it, partly from what was obſerved by others, communicated to the Royal Society, by* John Eames, *F. R. S. as he received it in a Letter from Mr.* Evan Davies.

V. *The Poſtſcript of a Letter from* George Martin, *M. D. to* William Græme, *M.D. F.R.S. giving an Account of the Operation of* Bronchotome, *as it was performed at St.* Andrews.

VI. Obſervationes Cœleſtes multifariæ, *Annis* 1728 *&* 1729. Pekini *in* Sinis *habitæ, & ad Rev. P.* Johannem Baptiſtam Carbone, *Soc. Jeſ. tranſmiſſæ; ex ejuſdem Cl. Viri Epiſtola ad* Jacobum de Caſtro Sarmento, *M. D. Col. Med.* Lond. *Lic. & R. S. S.*

VII. Nova Literaria Phyſico-Medica curioſa; *containing a Deſcription of the* Cereus *which flowered at* Norimberg *in the Year* 1730. *Communicated by* Jo. Georg. Steigertahl *Arch. Reg. Hanov. Prof. Helm. Soc. Honorar. Coll. Med.* Lond. *& R. S. S. to Sir* Hans Sloane *Bart. Pr. R. S. & Coll. Med.* Lond. *Tranſlated from the* Latin *by* T. Stack, *M. D.*

I. *An*

I. *An Account of the præternatural Delivery of a* Fœtus *at the* Anus; *communicated by Mr.* Nourſe, *one of the Aſſiſtant Surgeons to St.* Bartholomew's-Hoſpital; *Demonſtrator of Anatomy at* Surgeons-Hall, *and F. R. S.*

THE kind Invitation I had from Mr. *Giffard* the Surgeon, to aſſiſt at the Opening of a Patient of his, gives me an Opportunity to lay before this Society, a Caſe as extraordinary, and I believe very like what Monſ. *Littre* has given us in the Memoirs of the Royal Academy of Sciences at *Paris*, *Ann.* 1702; (*viz.*) where a *Fœtus* had no other *Nidus* than the *Ovary*; and was brought forth through the *Rectum*. The Symtoms previous to this præternatural Birth, the forementioned Gentleman has very faithfully drawn up; be pleaſed therefore to take them in his own Words.

'I was ſent for about the middle of *Auguſt* laſt, to 'a Woman who then judged herſelf to be between 'three and four Months gone with Child; ſhe had all 'the Symptoms preceding a Miſcarriage, and upon 'touching, I found the *Os Tincæ* ſomewhat dilated and 'ſpread, from whence I concluded a Miſcarriage would 'enſue, and therefore ordered what I thought proper 'to promote it; but I was ſometime after informed by 'her Husband, that although ſhe before believed that 'ſhe had miſcarried, yet that ſhe now thought herſelf 'Quick; as feeling ſomewhat to move within her Belly, 'agreeable to what ſhe had perceived after former 'Quickenings. Thus it paſſed on for about ſix or ſeven

'Weeks; in which Time ſhe grew much bigger, and 'the Motion more perceptible; ſo that there remained 'no Doubt of her being with Child. About the third 'of *October* ſhe was ſeized with violent Pains in her 'Belly and Back; which daily increaſing, her Siſter, 'by her Deſire, came to me on the ſixth, when I went 'to her, and found her labouring under very great 'Pains, and other Complaints like thoſe preceding a 'Miſcarriage or Delivery: But to be better ſatisfied, 'and to ſtrengthen my Opinion, I paſſed up two Fin-'gers into the *Vagina*, to examine by the Touch, whe-'ther the *Os Tincæ* began to open and ſpread. I there 'felt a large and unuſual Fulneſs and Tenſion, which 'I then judged to be the Body of the *Uterus* ſunk low 'into the *Vagina*, and much diſtending it, and extend-'ing backwards, and preſſing againſt the *Rectum*, ſo 'that the Excrements could not readily paſs, neither 'could ſhe, from its Preſſure upon the Neck of the 'Bladder, freely make Water. I could not find the *Os* '*Tincæ*, although I very carefully examined all a-'bout with the Ends of my Fingers; wherefore I then 'judged that the *Fundus Uteri* muſt have receded 'from its natural Poſition, and be bent backwards to-'wards the *Rectum*: In which Opinion I was the 'more ſtrengthened from the Fulneſs I before obſerved, 'ſtretching backwards; and therefore concluded that 'the *Os Tincæ* muſt be very forward: Wherefore I en-'deavoured to paſs my Fingers between the *Os Pu-'bis* and the Fulneſs which preſſed againſt the upper 'Edge of the ſaid Bone. This with ſome Difficulty I 'effected, and at length about two or three Inches a-'bove the ſaid Bone, I felt the *Os Tincæ* with the 'Ends of my Fingers. The Cauſe of this Situation will

'more

'more clearly appear in the Purſuit of this Account. 'I ordered her anodyne and quieting Medicines to re-'lieve her Pain, which ſhe was obliged to repeat at 'leaſt every twelve Hours, with proper Cordials to ſup-'port Nature; and ſometimes Clyſters. Thus matters 'continued to the twentieth of the ſaid Month, only 'that for ſome Days before, a Water tinged with Blood 'came away, as ſhe imagined, through the *Anus*, and 'which ſhe believed proceeded from the Piles, with 'which ſhe was ſometimes troubled.

'On the twentieth, her Husband came to me about 'ſix of the Clock in the Morning, telling me that the 'Midwife had brought away a *Fœtus*, but could not 'compleat her Buſineſs; whereupon I immediately 'went to the Midwife, who upon my coming told me 'that a *Fœtus* was protruded through the *Anus*; and 'to confirm it, deſired me to examine, which I did im-'mediately, and found the *Funis Umbilicalis* hanging 'out about two or three Inches beyond the *Anus*, 'and paſſing up through the ſame: I therefore paſſed my 'two fore Fingers by the String into the *Anus*; when 'I found about three Inches up, an Opening, as I then 'judged, into the *Uterus*, wide enough to admit the 'Ends of three or four Fingers, and the *Funis Um-'bilicalis* paſſing into it; from hence I was aſſured that 'the *Fœtus* came out that Way. I endeavoured, with 'my Fingers paſſed into the Opening, to bring away 'the *Placenta*; but as it was very rotten, it tore a-'way between my Fingers, ſo that I was forced to 'bring it in ſmall Pieces, and was at laſt obliged to 'leave a large Part of it. The *Septum* or Partition 'between the *Anus* and *Vagina* was entirely whole, 'and no Perforation through it. From theſe Appear-

'ances I then concluded that a Mortification muſt have 'begun in the *Uterus*, and ſo from its Contiguity 'be communicated to the *Rectum*; ſo that Nature en-'deavouring to expel what was contained, and forcing 'it againſt this Part already mortified, and conſequent-'ly ready to give way and ſeparate upon any Preſſure 'made againſt it, produced this Opening, and the Pro-'truſion of the *Fœtus* through it into the *Rectum*, and 'ſo on through the *Anus*.

'There was a large Diſcharge of grumous Blood 'and other Subſtances through the *Anus*, which con-'tinued coming away until the twenty-ſixth of the 'aforeſaid Month, when the Woman died about three 'of the Clock in the Afternoon.

'I ſhould have obſerved that there was a Fulneſs 'and Hardneſs very perceptible, to be felt outwardly 'in the fore-part of the Belly, ſome diſtance below 'the Navel, from the Time that the *Fœtus* came away 'to her Death; which upon opening the Body, I was 'well aſſured, was the *Uterus* forced upwards and 'forwards by a *Sacculus*, which being large and di-'ſtended filled up the *Pelvis*; and by its Bulk preſſed 'the *Uterus* forwards. The *Fœtus* was perfect in all 'its Parts; but much waſted and ſhrunk from its be-'ing ſome time dead; and conſequently putrified.'

This we thought neceſſary to premiſe an Examination of the Parts (which I have here brought) whoſe Appearances upon Diſſection, were as follow.

The *Vagina*, *Uterus*, *Ligamenta Rotunda*, left *Ovary*, *Fallopian Tube*, and *Ligamentum Latum* on that ſide, together with the Hypogaſtrick, and Spermatick Veſſels on the ſame Side, were in a natural State. The *Fallopian Tube* on the right Side, we traced

Philo: Trans: N° 416.

Fig. 1.

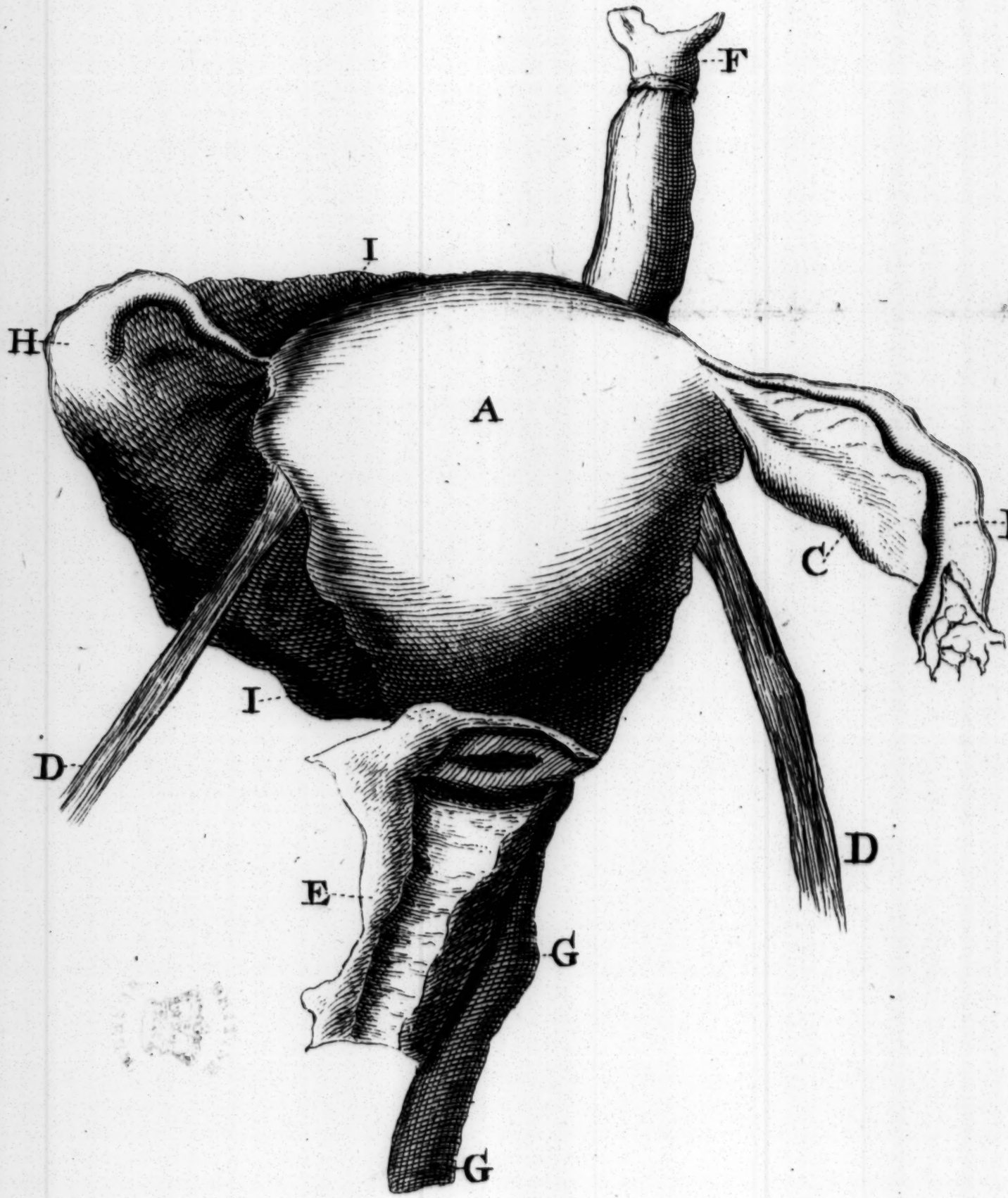
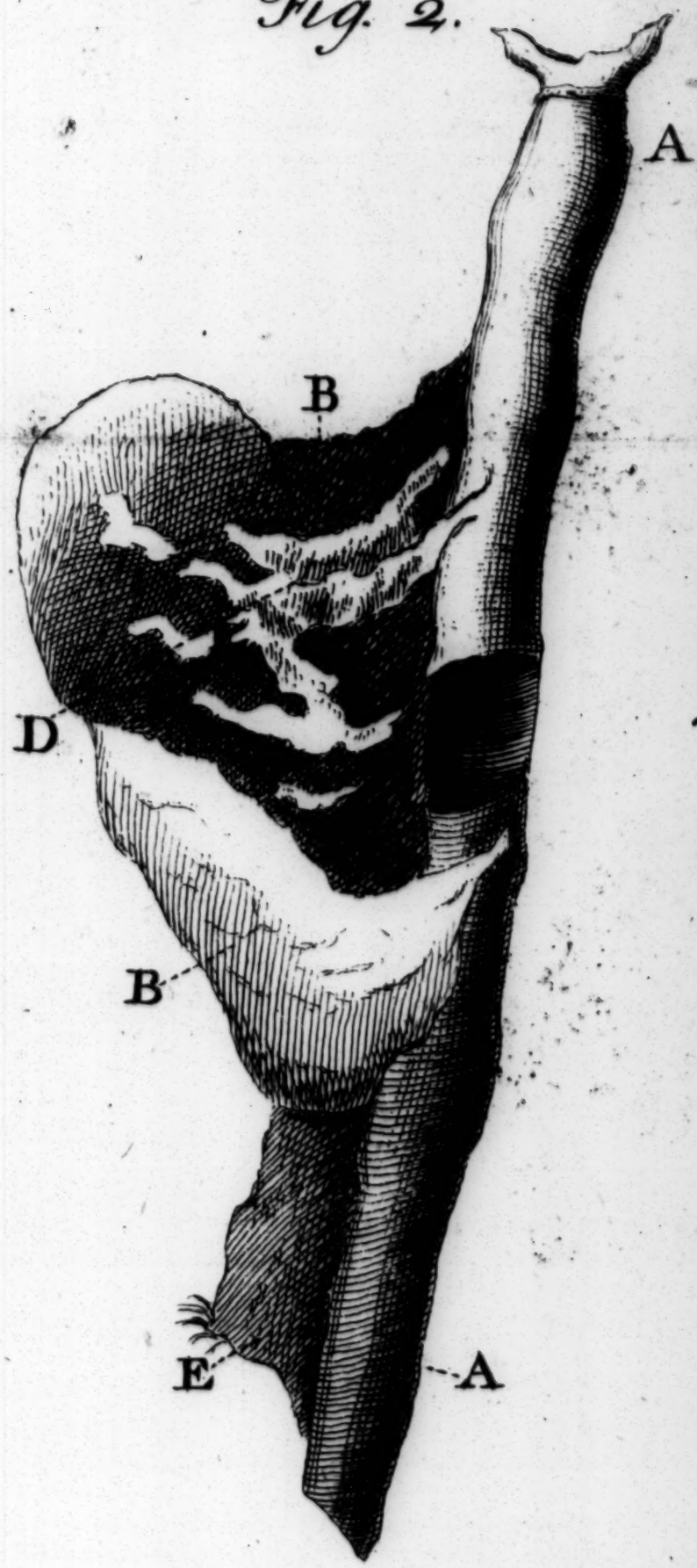


Fig. 2.



traced from the *Fundus Uteri* almoſt to the *Morſus Diaboli*; where it was confuſedly united with, and opened into the *Sacculus* hereafter to be deſcribed. The *Ovary* on this ſide with the *Ligamentum Latum*, was dilated into a large *Sacculus* of an irregular Form, extending itſelf behind the *Uterus* (to the poſterior Paries of which it adhered) and paſſing on towards the left, was connected to that Part of the *Colon* that terminates in the *Rectum*, and the *Rectum*. In this *Sacculus* we found great part of the *Placenta*, and the Remains of lacerated Membranes, beſides the Aperture of the *Fallopian Tube* mentioned before, and another aboutfour Inches in Diameter into the Middle of the *Rectum*: That part of the Ureter on the right Side which lies between the Ovary and the Kidney was dilated, and ſo was that part of the *Rectum* between the Aperture into it, and the End of the *Colon*; both which were cauſed from the Contents of theſe Canals being obſtructed in their Paſſage.

FIG. I.

Shews the *Uterus*, with the *Sacculus* behind it, part of the *Colon* and the *Rectum*; the *Fallopian Tubes*, *Ovary* on the left Side; *Ligamenta Rotunda*; and the *Vagina* laid open to the *Os Tincæ*.

A The *Uterus*.
B The *Fallopian Tube* on the left Side.
C The *Ovary* on the ſame Side.
D The *Ligamenta Rotunda*
E The *Vagina* laid open.
F That part of the *Colon* that terminates in the *Rectum*.
G The *Rectum* continued to the *Anus* under the *Vagina*.

H The

H The *Fallopian Tube* on the right Side, whoſe Extremity opens into the *Sacculus* formed from the *Ovary*.

I The *Sacculus* extending itſelf behind the *Uterus*; wherein we found the *Placenta* and ſeveral lacerated Membranes; and from whence there was a large Opening into the *Rectum*.

FIG. II.

Shews the Inſide of the *Sacculus* and its Aperture into the *Rectum*.

A The Inteſtine.
B The *Sacculus* adhering to it.
C The Opening from the *Sacculus* into the *Rectum*.
D The Membranes found within the *Sacculus*.
E The *Vagina* turned to the Right.

II. *An Extract of a Letter from Mr.* William Stevenſon *to* Benj. Hoadly, *M. D. F. R. S. Containing an Account of an Obſervation of an Eclipſe of the Moon, on* July 29, 1729, *made in* Barbados *by Mr.* Stevenſon's *Brother.*

'HE took care to regulate a very good Clock, and 'brought it to true Time about 14 Days 'before the Eclipſe. On the Day it happened, he 'ſaw the Sun ſet, and found the Clock right, accord-'ing to the mean Time, Refraction allowed. At the 'Beginning of the Eclipſe, the Moon was clouded. 'At 7 H. 18 M. (in the Evening) apparent Time, 'he ſaw the Moon 2 Digits Eclipſed, about 30 Degr.

'to the left of its Nadir-Point. At 8 H. 11 M. ſhe 'totally immerged into the Earth's Shadow, about '30 Degr. to the right Hand of her Vertical Point. 'At 9 H. 51 M. ſhe emerged out of the Shadow, '79 or 80 Degr. to the left of her Nadir-Point. At '10 H. 50 M. the Eclipſe ended, 88 Degr. to the 'right of her Vertical Point. In this, and all the 'other Obſervations he made of both Solar and Lunar 'Eclipſes, during ſeveral Years he has been in *Barba-* '*dos*, he found that they always happened 10 Mi- 'nutes ſooner than his Computation. Whence he con- 'cludes, that that Iſland lies 2 Degr. and a Half 'more Weſterly than is generally ſuppoſed.'

III. *The Anatomical Preparation of Vegetables, by* Albertus Seba, *F. R. S. Communicated to the Royal Society by Sir* Hans Sloane, *Bar^t. Pr. R. S. and Col. Med.* Lond. *Tranſlated from the* German, *by Mr.* Zolman, *F. R. S.*

TAKE Leaves of Trées or other Vegetables, that are ſomewhat ſubſtantial and tough, and have woody Fibres; as for Inſtance, Leaves of Orange Trees, of Lemon, Jaſmin, Laurel, Roſe-Trees, of Cherry, Apricock, Peach, Plum, Apple, Pear, and Trees of Popler, Pine, Oak, *&c.*

There are many ſorts of Leaves that have no ſuch woody Fibres or Veins; as for Inſtance, Vine and Lime-Tree Leaves.

Thoſe

Thoſe of the firſt Sort above-mentioned, and the like are to be gathered in *June* or *July*, when they are moſt perfect, not touched by Worms and Caterpillars. They are to be put into an earthen Pot or a wide Glaſs Veſſel, with a good deal of Rain-Water poured over them, and afterwards left in the open Air, uncovered and expoſed to the Warmth of the Sun. The Water muſt always ſtand above the Leaves, and if it evaporates ſo as to leave them dry, freſh Water muſt be poured on. Thus the Leaves begin to putrify; ſome ſorts will be rotten in a Month, others hold out two Months and longer. When the two external Membranes begin to ſeparate, and the green Subſtance of the Leaf to grow liquid, then it is Time to perform the Operation. The Leaf is to be put into a white and flat earthen Plate or Diſh filled with clear Water; then being gently ſqueezed with the Finger, the Membranes begin to open in the Extremities, and the green Subſtance comes out. Take the Membranes on both ſides dexterouſly off with the Finger, which muſt be moſt carefully done in the middle of the Leaf near the Stalk: If there is once an Opening, the reſt follows eaſily. The Skeleton that remains between, is afterwards waſhed in clear Water, and kept in a Book.

The Method with relation to Fruit; as Apples, Pears, Plums, Cherries, Peaches and the like, is as follows.

The fineſt and largeſt Pears that are ſoft and not ſtony, are moſt proper for this ſort of Anatomy. Firſt, they are to be nicely pared without ſqueezing them, and Care taken not to hurt the Stalk or the Crown. This done, put as many, and of ſuch ſorts as you have pitched upon, into a Pot of Rain or freſh

Spring-

Spring-Water; cover it, and let them boil gently till they grow throughly ſoft; then take them out and put them into a Veſſel of cold Water: The Pear which is to be anatomized, is to be put into a Diſh filled with cold Water; then take and hold it by the Stalk with one Hand, and with one Finger and the Thumb of the other Hand, rub the Pulp of the Pear gently off, beginning near the Stalk and rubbing equally towards the Crown, and you will eaſily ſee in the Water how the Pulp ſeparates from the Fibres, which being moſt tender towards the Extremities, it is there the greateſt Care is to be taken. No Inſtrument is of any uſe in this Operation, except laſt of all a Penknife to ſeparate the Pulp ſticking to the Core. In order to ſee how the Operation advances, you may fling away the muddy Water from Time to Time, and pour on clean: All being ſeparated, the Skeleton is to be preſerved in Spirits of Wine rectified. The ſame to be obſerved with relation to Apples, Plums, Peaches and the like.

Turnips and other Roots, that have woody Fibres or Ribs, müſt be boiled without paring, till they grow ſoft, and the Pulp comes off. Not only many ſorts of Roots, but alſo the Barks of ſeveral Trees may be reduced after this Method into Skeletons, preſenting rare and curious Views of Vegetables.

Hence one muſt acknowledge the inimitable Wonders of the Almighty, how wonderfully he has created every thing, yet ſo that all Creatures in Nature tend to Corruption. Therefore God having done every thing well, we ought to honour, praiſe and thank him for his Mercy, Goodneſs and Kindneſs, which in his Love he has made Mankind Partakers of.

I have invented the aboveſaid Preparation through my own Speculation, and with great Pains, without the Aſſiſtance of any Man living: I have made frequent Experiments of it, and do now communicate it very freely and readily.

IV. *An Account of what happened from Thunder in* Carmarthenſhire; *partly had from the Woman's Mouth that ſuffered by it, partly from what was obſerved by others, communicated to the Royal Society, by* John Eames, *F. R. S. as he received it in a Letter from Mr.* Evan Davies.

PENCARREG, *Saturday December* 6, 1729. In the Afternoon of the ſame Day there happened terrible Thunder and Lightning, which alarmed the whole Neighbourhood; and about four of the Clock of the ſame Evening, or thereabouts, as the Wife of one *William Griff. Morgan* of the ſaid Pariſh, was carrying a Pail of Water into the Houſe, being no ſooner come over the Threſhold into a ſmall Entry that leads towards the Fire, there broke ſuch a violent Clap of Thunder, after its Forerunner (Lightning) that ſhe and three of her Children were very ſurprizingly ſtruck dead, and inſtantly bereaved of their Senſes, that they lay (they know not how long) miſerable and ghoſtly Monuments of the terrible Shock, being the moſt diſmal Sight that was ever known in thoſe Parts; and I think, by the Report (if my Memory fails me not) they lay weltring in their Blood, before they recovered, and were able to creep to the Bed, till the next Neighbo ur happened to come in (the Husband being

then abroad at his Day-Labour) to aſſiſt them. The Cauſe, whatever it was, whether Thunder-Bolt, Thunder-Ball, Lightning, &c. (The Learned are beſt able to diſtinguiſh) ſtruck ('tis imagined) at the Eaſt End, near the Foundation, into the Hearth, and cleaved in two a thick Stone of about half a Yard in Breadth beyond the Fire (which we commonly call in *Welſh Pentan*) One Part whereof ſtill remains, and that cleft, but the other is ſhattered into ſmall Particles and Splinters, and thoſe ſhot into their Fleſh, which ('tis preſumed) did the moſt Hurt. About twenty-four or more of thoſe Stones were from Time to Time taken out of their Wounds; two of thoſe, being all I could get, I have ſent for an Inſtance. To proceed in as regular a Method as poſſibly I can with the Account, it appears, that afterwards it forced its Way out through the Wall on the South-ſide within the Compaſs of the Hearth, when it made a terrible Breach from Top to Bottom, and removed the Stones from the Foundation, and nigh thereto made a deep Hole perpendicular in the Earth, that one might thruſt in a Staff to the Wriſt, as the Woman herſelf informed me. That part of the Wall was made up before I viewed the Spot. By the Violence of it, the Brand-Irons and Legs thereof were ſtrained, and by endeavouring to put them to their true Poſition as before, they were ſo burnt up, that they fell a-ſunder like ruſty Iron, or Timber Worm-eaten, and ſo became of no further Uſe. The Partitions in the Houſe, which were of no ſtrong Subſtance (being watled, ſuch as they have in Country Houſes) were moved out of place, and a Cheſt full of Corn forced down towards the Door, ſome Yards from the Place it ſtood. The Bucket the Woman had in her

Hand, and other wooden Veſſels in the Houſe, were all or moſt of them ſhattered, Diſhes and Spoons, &c. blown off, and after ſome Days, found and gathered in the Garden, on the North-ſide of the Houſe, ſplit and broken, with ſome Yarn that was hanging in the Top of the Houſe, found out of Doors a while after; and many more Diſorders than I am able to account for at preſent.

WOUNDS *and* BRUISES.

The Woman has quite loſt her left Eye, which ſhe perceived herſelf to be blind of, after ſhe came to herſelf. The poor Creature was ſpeechleſs for a Week or nine Days, and could not ſwallow. She has lately had a few Stones come out from the Roof of the Mouth, under the Tongue, and other Parts inwardly: The Tip of her Tongue taken off, as far as I can gueſs, for ſhe is ſtill liſping; three of the fore Teeth of the under Jaw broken, with the lower Lip ſlit, but now pretty well healed; two of the Right-hand Fingers, the Second and Third quite off, and the Colour of that Hand ſtill like a Flame of Fire, as if there were yet remaining ſome igneous Particles in it. She has a terrible Gaſh upon that Shoulder between the Joints, that once one might cover an Egg in it, very painful, beſides three or more Bruiſes upon the Arm down to the Wriſt, that ſhe is not able to heave or lift it up, without the Help of the other Hand, beſides ſeveral other Wounds and Bruiſes over great part of her Body. A Boy (an Ideot) had his Hair all ſindged, his Face and Breaſt all ſcorched with Bliſters like Bladders running from the raw Fleſh, with ſeveral Stones taken out from his Body and Legs, and two other ſmall Children ſuffer-

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ed greatly; ſo that the Wounds are reckoned by the Woman that uſed to dreſs them, to be Thirty at leaſt between the Mother and Children: only one Girl about ten years old, or thereabouts, that ſtood at a Diſtance next the Door eſcaped, having her Cloaths only ſindged, and no Hurt done her. I had almoſt forgot to mention the ſeveral Splinters of Bones taken out in dreſſing their Wounds, that I could not get. It is worth obſerving alſo, that they did ſmell ſo ſtrong of the Sulphur and bituminous Matter for ſome Days, that one could hardly go near them. They are now, by the Goodneſs of God bleſſing the Means uſed for their Recovery, free from any grievous Pain to complain of; ſo that they go about. This is all the Account I can give you, huddled up in ſome Haſt, which may ſerve till you come yourſelf and take a more exact Survey.

What Concluſion to draw from hence I know not, tho' ſome are very forward to pronounce that it was God's Judgment upon them; but as the Ways of Divine Providence are unſearchable, *who cauſes it to rain upon the juſt and the unjuſt*, I think People ought not dive too far into thoſe inſcrutable Arcana's; but only pray to God to preſerve us evermore, and to avert ſuch heavy Judgments our Sins *may juſtly deſerve, by ſuch or like* terrible Viſitations.

This Account was ſent me by Mr. *Jenkin Jenkins* a Clergyman, who lives in that Neighbourhood: About half a Year after I was that Way, and viewed the Breach made in the Houſe, and the Wounds which the Woman and her Children had received by the Stones lodged in their Bodies, ſome of which were not then healed. The Woman then gave me the little Piece of a Stone, wrapp'd up in the brown Paper, which ſhe

ſhe ſaid ſhe had taken out of her Tongue, above five Months after this Diſſaſter had happened.

Evan Davies.

V. *The Poſtſcript of a Letter from* George Martin, *M. D. to* William Græme, *M.D. F.R.S. giving an Account of the Operation of* Bronchotome, *as it was performed at* St. Andrews.

POSTSCRIPT.

I Was called to a young Lad, who being in ſuch a good State of Health, as to be then making a Viſit to ſome of his Comrades in another Street, was all of a ſudden taken ill with a violent Trouble in his Throat; in which however, I could ſee nothing wrong, the *Amygdalæ*, and other Parts in view, being in all Appearance ſound enough, but only looking a little drier than ordinary; without any external Tumour appearing about the *Larynx*, and no conſiderable Frequency or Strength in his Pulſe. But he had great Pain and a *Dyſpnæa*, with an Impoſſibility of ſwallowing either Liquids or Solids; every thing returning forcibly by the Mouth and Noſe, when he made an Effort to get it over. From all which I reckoned it an *Angina* of one of the worſt Kinds, *ſine apparente tumore* (See *Hippocr. Prognoſt.* xxiii. 3. & *Prænot. Coac.* iii. 96.) and the Seat of the Diſeaſe in the *Larynx*,

rynx and the Fibres common to it, and the Top of the Gullet.

Notwithſtanding repeated Bloodings, Bliſtering betwixt his Shoulders, Cupping, *&c.* whereof it is needleſs to give you a particular Detail, the Diſeaſe continued ſo obſtinate, and the Patient ſo like to ſuffocate, that next Day in the Afternoon his Friends, although very averſe in the Morning, when I firſt propoſed the piercing the Windpipe, at length earneſtly deſired that the Operation might be performed; and the poor Lad bad us try any Experiment to preſerve his Life. He had good Reaſon ſo to do; for indeed, in all Probability, in a few Hours he would have been ſtrangled to Death moſt miſerably, *conſtante mente, integriſque ſenſibus*, as the elegant *Fernelius (Pathолog.* v. 9.) expreſſeth it. Whence you ſee it was not out of an itching Deſire of making Experiments, or a wanton Officiouſneſs, that we directly ſet about the Operation. Which was done with ſuch Succeſs, that in leſs than four Days, his Breathing being perfectly eaſy, and his Deglutition being almoſt ſo, we removed the *Cannula*, and left the *Glottis* to do its own Office.

According to *Cælius Aurelianus (Acut.* iii. 4.) and the Author of the *Liber Introductorius* (cap. 13.) aſcribed to *Galen*, *Bronchotomy* was propoſed by *Aſclepiades* (however inconſiſtent with his Delicacy, and the reſt of his Character, the ſeeming Harſhneſs of this Operation may appear) and is deſcribed and earneſtly recommended by almoſt all the ſyſtematical Writers of Surgery from *Paulus* of *Ægina* (*de re Medic.* vi. 33.) and, as he ſays, *Antyllus*, and ſome other of the beſt Surgeons before him, down to the preſent Times. But when they are at ſo much Pains to defend the Reaſonableneſs

ableneſs of it, and when they ſhew ſo much Fondneſs of citing and telling Examples of the healing accidental Wounds of the *Trachea*, without ever mentioning their own regular Performance of the Operation (which would have been a ſhorter and much more effectual Recommendation of it) when I ſay, I conſider all this, I find myſelf obliged to think that it has very ſeldom been reduced to Practice. So rare had it been that *Aretæus*, a Man of vaſt Judgment and Skill in Diſeaſes (*Cur. Acut.* i. 7.) thought the Operation had never been actually done with Succeſs. And *Cælius Aurelianus* looked on it as an impracticable Whim of *Aſclepiades*. Neither *Avenzoar* (*Medic.* i. x. 14.) nor *Albucaſis* (*Chirurg.* ii. 43.) knew any of their Countrymen who had undertaken it. And the *Arabians* are reputed to have been hardy enough Surgeons. The moſt that I know of amongſt them of this Kind is in *Avenzoar*, who tried the Experiment on a Goat, and cured the Wound; which ſhews the Ingeniouſneſs and Induſtry of the Author. For as to what you will find ſome Writers telling you, that *Raſes* (*Contin.* vii. Fol. m. 77.) ſaw *Andruſius* the Phyſician do it (the Copy I looked into, printed at *Venice* 1505, calls him *Anciliſius*: and prehaps it ſhould be *Antyllus* for them both) I think this flows from a miſtaken Interpretation of that Author's Meaning. Since you will read the whole Context, I think you will eaſily perceive that all he ſays of the Operation is upon hearſay; and conſequently, that he had only ſeen in Books, that ſuch a one had done it. That moſt accompliſhed Anatomiſt and Surgeon *Fabricus ab Aquapendente* (*Operat. Chirurg.* xliv. p. 477.) frankly acknowleges, that neither he nor any of his Contemporaries had ever ventured

to

to perform it. Neither does his Succeſſor in the Profeſſion of Surgery, and his Rival in Anatomy, *Julius Caſſerius* of *Placentia* (*De Voc. Org.* i. 20.) pretend to have done it; though he has endeavoured to illuſtrate the Operation by ſome very neat Figures; which you will not readily ſuſpect to be from any but dead Bodies. And next to him *M. Aurelius Severinus* (*Chirurg, Effic.* ii. 40.) who was a very judicious and learned Man, and the beſt and boldeſt Surgeon of his Time; though he recommends it with a great deal of Warmth and Keenneſs, yet it ſeems, even in his latter Days, he never had Occaſion to try it: So that the firſt undoubted and diſtinctly recorded Hiſtory I can find of this Operation being actually practiſed, is in the learned *Anton. Muſa Braſavolus* (*Com. in Hippocr. de Diæt. in acut.* iv. 35.) who performed it in a deſperate Squinance, when the Surgeon refuſed to do it; and repeated it again in the like Caſe. Mr. *Arnaud* the *Frenchman* did it; but his Patient died (See *Garengeot Operat. Chirurg.* xxxi. p. 489.) However, his Countryman Mr. *Binard* had better Succeſs (*Garengeot ibid.* xxxii. p. 498.) Dr. *Freind* (*Hiſt. Phyſ.* I. p. 206.) cites *Purman* doing it: and (*p.* 207.) tells us of another Caſe communicated to him by a Surgeon whom he does not name. And beſides theſe, I believe there are but few Inſtances can be produced, of any who really performed the Operation on a living Perſon. I hear now that Mr. *Baxter*, a Surgeon in *Coupar* of *Fife*, not far from us, and Dr. *Oliphant* in *Gask* in *Perthſhire*, did it with very good Succeſs within theſe few Years.

In the actual Performance of the Operation they certainly did, or might have obſerved ſome things omitted by Authors, and even ſome not perfectly agreeing with the common Accounts that are given of it. I think it

worth while to notice that in the very cutting, before we got a free Aperture into the *Trachea*, and the Pipe introduced, the Patient felt ſome Relief; which I thought might be aſcribed to the Effuſion of Blood in the Operation; a ſmall Quantity whereof evacuated ſo near, the Part affected could not, according to the true Laws of *Hydraulicks*, and the Obſervations and Practice of the Ancients (however diſagreeing with *Bellini*'s *Theory*) but make a more conſiderable Revulſion, than a much greater taken away at a great Diſtance. Whence the judicious *Fab. ab Aquapendente* (p. 480.) with very good Reaſon ſuppoſed that by the Derivation here, the Patient would be more apt to feel ſome Relief than Trouble. Which *Julius Guaſtavinus* too made no Doubt of in his Diſpute upon this Subject againſt *Aretæus* (See *M. Aur. Severin.* p. 103.) And now their Suppoſition and Conjecture is confirmed by Experience. And ſince there continued a greater Flux of Blood to the Wound while it was ſuppurating, I reckoned the Circulation in the Muſcles of the *Larynx* to be with leſs Force than ordinary, and ſo probably to contribute to the diminiſhing the Strength of the Voice, which for a good many Days after the Operation, was obſerved to be much weaker than it uſed to be. Which I all along thought was rather owing to this, and the Lowneſs of his Body by his ſlender Diet, *&c.* than to any Hurt of the recurrent Nerves; which being cut, do indeed deſtroy the Voice, but by their Deepneſs, are in leſs Hazard than ſome in old Times uſed to think.

In doing the Operation on a living Perſon, one cannot but remark at the very firſt, that the *Cannula* ſhould not be made near ſo ſhort as is ordinarily propoſed

poſed in Books and chirurgical Lectures: For we found that upon cutting the Parts, eſpecially the *Thyroid Gland* (which is not ſo much minded in moſt of the common Deſcriptions of this Operation as ſhould be) ſoon become ſo much tumified, that it will require a Pipe above an Inch long, to penetrate ſufficiently into the *Aſpera Arteria.* Which is more than double of *Garangeot*'s Allowance of ſix Lines; who is one of the recenteſt Writers, and has communicated to us all the Surgery the *French* are Maſters of. The Leaden Pipe we had prepared not anſwering the Deſign, that which we made uſe of was too long and too ſmall, being the common *Cannula* for tapping in the Dropſy, flatned a little at the End, and hindered by a very thick Compreſs, perforated in the Middle, from penetrating too deep into the *Trachea.*

The mucous Particles and Steams ariſing from the Lungs, made a conſtant weeping of a thin ſlavery Liquor from the Mouth of the Pipe, part whereof thickening, and ſtuffing its Cavity, ſometimes very much incommoded the Patient's Reſpiration by it, ſo as to render it neceſſary to have it taken out and cleaned. And hence, when ſome Moderns very preciſely bid us put a thin Slice of Spunge, or a bit of Muſlin, *&c.* cloſe over the Orifice of the *Cannula*, to prevent the Ingreſs of Duſt, Downs, or the like, into the Lungs, it confirms what I ſaid before of the Unuſualneſs of the Operation, and looks as if they had only contemplated the Matter *in Abſtracto*, as the *Metaphyſicians* ſay, without conſidering they had not to do with a pure thin dry Air, but with a heterogeneous Fluid, that is moiſtened and thickened with viſcid Particles, which are apt to run together in ſtiff Concretions. And therefore, though

it muſt be acknowledged that there would have been leſs Hazard of a Stoppage, if our *Cannula* had been ſhorter, and wider, eſpecially at the Mouth, I cannot but think it an ingenious Propoſal of one of our Miniſters here, to make the Pipe double, or one within another; that the Innermoſt might ſafely and eaſily be taken out and cleaned when neceſſary, without any Moleſtation to the Patient: For it is no ſmall Trouble to him to be obliged to have the Bandage frequently removed, and the Pipe fitted a-new to the Orifice made in the *Trachea*.

And indeed we found no Inconvenience in our Patient's breathing the Air as it paſſed through the Pipe, without any cleanſing or intercepting *Medium*, though the Houſe was none of the cleaneſt, being an ordinary *Tradeſman*'s here. But if by a larger, and conſequently a more patent Tube, one, eſpecially of more delicate and tickliſh Lungs, ſhould be incommoded that Way, I think the Acceſs of Duſt, *&c.* might conveniently enough be hindered by a Piece of Muſlin, or thin Hair-Crape, tied ſlackly about the Neck over the Orifice of the *Cannula*, ſo however as not to touch it, or to be wetted by the Liquor coming from it.

The Patient was ſoon perfectly recovered: He breaths, ſpeaks, eats, drinks, and performs all the other Offices of Life, and goes about his Calling as formerly. And now I cannot but notice the needleſs Pain ſome Writers are in about healing up the Wound by Bandaging, Stiching, *&c.* For we found it eaſily to fill up of itſelf in a very few Days, by only dreſſing it every other Day or ſo with a ſoft Tent, made leſs and leſs every Dreſſing, and armed in the common Way with *Linıment. Arcæi.* I believe indeed it

would

would have taken a little more Time to heal, if our Patient had been older.

Having, as you will eaſily perceive, omitted thoſe things that were common or of leſs Moment, I have ſet down what ſeemed moſt remarkable in the Courſe of this Operation. Upon which Subject I ſhould not have had ſo much to ſay if this elegant Method of reſcuing one from imminent Danger, and the moſt difficult kind of Death, had not been ordinarily deſcribed more from Theory and Fancy than from Nature and Practice: And if Surgeons had been accuſtomed to be half as bold to aſſiſt Nature in ſuch an Extremity as both they and many Phyſicians are ſometimes officious to diſturb her regular and ſalutary Steps.

VI. Obſervationes Cœleſtes multifariæ, *Annis* 1728 & 1729. Pekini *in* Sinis *habitæ*, & *ad Rev. P.* Johannem Baptiſtam Carbone, *Soc. Jeſ. tranſmiſſæ*; *ex ejuſdem Cl. Viri Epiſtola ad* Jacobum de Caſtro Sarmento, *M. D. Col. Med.* Lond. *Lic.* & *R. S. S.*

Congreſſus Lunæ cum aliquot ſtellis obſervati Pekini à Nov. 1728, *uſque ad* Nov. *anni* 1729.

NOV. die 20 5^h 0′ 42″ mane Luna obtexit ſtellam *v Leonis* locus immerſionis erat proxime contra Roccam.

6^h 21′ 55″ prodiens Stella ſtabat in recta cum Reinoldo & Grimaldo; adeoque locus emerſionis prope Beroſum, & tranſitus ferme centralis.

Dec.

Dec. die 6. veſperi Conjunctio *Saturni* cum Luna, ſed Luna non niſi poſt $7^{h}\frac{1}{4}$ è nubibus promicante, Captæ ſunt tantum ſequentes diſtantiæ Saturni à propiore limbo Lunæ cujus diameter 30′ 45″.

Hora 7 18	diſt.	17′ 55″	♄ in recta	ex cuſpide bor. per	Fracaſtorem.
25		20 30			Iſidorum.
33		23 0			Santbecium.
40		25 10			Petavium.

1729. *Mart.* die 8. 11^{h} 18′ P. M. Luna obtexit ſtellam boreo-orientalem trapezii, quod eſt infra pedes aurigæ. 12^{h} 12′ emerſit ſtella è regione Meſſallæ. Die 11. 7^{h} 56′ 30″ veſp. Luna obtexit ſtellam *n Cancri* Locus immerſionis erat contra Schikardum. Emerſio, quæ fuit contra Petavium, paulo tardius notata eſt 9^{h} 2′ 30″ accideret autem proxime 8^{h} 59′.

April. die 2. veſp. Conjunctio Lunæ cum *Pleiadibus.*

8^{h} 23′ 2″ Luna obtexit ſtellulam borealiorem trianguli quaſi æquilateri, quod præcedit Pleiadas: Locus immerſionis contra Phocyllidem. 9^{h} 2′ 23″ abſorbuit ſtellam claram, quæ eſt ſupra Pleiadas ferme in recta linea cum *Taygeta* & *Electra*: Locus immerſionis videbatur eſſe contra Cardanum. 9^{h} 9′ 25″ Luna obtexit *Taygetam*, cujus immerſio erat contra Cabæum prope cuſpidem Lunæ auſtralem. 9^{h} 18′ 58″ immerſa eſt præcedens *Aſteropes*, contra Bartolum. 9^{h} 25′ 27″ immerſa eſt ſequens prope Caſatum. Emerſiones non poterant videri ob niniam undulationem lucidi limbi Lunæ atmoſphæram ſubeuntis.

Die 11. 8^{h} 12′ P. M. Luna obtexit ſtellam *v Leonis* directe contra Schikardum, ſtante Meſſalla in vertice Lunæ. Emerſit Stella 9^{h} 11′ 30″ paulo infra Langrenum, verticem Lunæ obtinente Mercurio.

Nov. die 7. manè transitus Lunæ per *Pleiadas*, cum borealium occultatione, ut sequitur.

H	′	″	
4	51	10	Immersit *Celæno* contra Zucchium.
4	53	6	Immersit *Taygeta* contra Crugerum.
5	17	30	Immersit *clara* Asteropes supra Ricciol.
5	18	20	Immersit *Maja* contra marg. occ. Schikardi.
dub. 5	21		Immersit *sequens* Asteropen contra Roccam.
5	37	10	Emersit *Celæno* recta contra Petavium.
6	2	20	Emersit *Taygeta* inter Langrenum, & mare Crisium.
6	15	30	Emersit Maja ad bor. Wendelini.

Emersio *Asteropes* ob diluculum nequit videri.

Eodem die vesp. 7^h 30′ 34″ ab Luna occultata fuit χ *Tauri* paulo infra Galilæum, quæ rursum emersit 8^h 33′ 15″ paulo supra Langrenum.

Immersiones & Emersiones Satellitum Jovis in, & hujus ex umbra ibidem observatæ.

Immersiones SATELL. I.

1728.	D.	H.	′	″	
Nov.	5	1	42	45	manè.
	12	3	36	15	manè.
	13	10	4	10	vesp.
	19	5	28	20	manè.
	20	11	55	56	vesp.
	28	1	47	50	manè.
	29	8	16	35	vesp.
Dec.	6	10	8	0	vesp.
	12	5	30	45	manè.
	15	6	27	0	vesp.
	22	8	17	0	vesp.

Emer-

Emerſiones SATELL. I.

		D.	H.	′	″	
1728.	*Dec.*	31	6	50	15	veſp.
1729.	*Jan.*	7	8	40	40	veſp.
		16	5	0	0	veſp.
		22	0	24	10	manè.
		23	6	52	20	veſp.
		30	8	46	15	veſp.
	Feb.	15	7	5	0	veſp.
	Mart.	10	7	21	40	veſp.
		17	9	19	50	veſp.
		24	11	16	15	veſp.

Immerſiones SATELL. I.

Nov.	1	2	58	45	manè.
	15	6	45	0	manè.
	17	1	13	15	manè.

Immerſiones SATELL. II.

Nov.	6	6	8	45	manè.
Dec.	1	3	3	20	manè.
	8	5	35	55	manè.
	18	9	25	0	veſp.

Emerſiones SATELL. II.

Jan.	2	5	21	30	manè.
	5	6	37	0	veſp.
	19	11	44	15	veſp.
	27	2	20	0	manè.

	D.	H.	′	″	
Feb.	6	6	14	18	veſp.
	13	8	49	0	veſp.
	20	11	28	45	veſp.
Mart.	10	6	9	0	veſp.
	17	8	49	40	veſp.
	24	11	30	10	veſp.
Maii	20	8	49	30	veſp.

Immerſiones SATELL. H.

Nov.	17	11	52	25 veſp.

Immerſiones SATELL. III.

1728.	D.	H.	′	″	
Nov.	6	10	4	10	veſp. diſparuit plenè immerſus in umbram.
	7	0	47	15	manè cœpit rurſum emergere.
	21	6	1	5	manè plenè immerſus fuit.
	24	5	24	20	veſp. plenè diſparuit in umbra.
1729.	24				
Jan.		82	1	40	veſp. denuò cœpit promicare.
	31	9	25	36	veſp. integrè immerſus fuit.
Feb.	1	0	21	0	manè rurſum prodire cœpit.
Mart.	15	9	33	0	veſp. plene immerſus in umbram.

1729. *Immerſiones* SATELL. IV.

Jan.	16	6	30	0	veſp. circiter, ingreſſus eſt umbram.
	16	9	24	0	veſp. cœpit rurſum ſenſim emicare.
Mart.	24	6	46	20	veſp. plenè diſparuit in umbra.
	24	10	10	20	veſp. denuò promicare cœpit.

Obſervatio eclipſis Lunæ totalis habita in publico Obſervatorio Pekinenſi A. C. 1729. *die* 14 *Februarii horis matutinis.*

Tota illa nocte continenter modicè ningebat, cœlo tamen ſic tenuiter nubilato, ut Lunares maculæ ſæpius utcunque diſtingui poſſent; quanquam rarius ac difficilius tempore immerſionis: Sub emerſionem enim paulatim cœlum ſerenatum fuit, ut circa finem jam penitus innube exiſteret.

Horologium correctum fuit per altitudines Arcturi & aquilæ, item ex culminante Spica *Virginis* ac Lance borea *Libræ*. Diameter Lunæ initio eclipſis micrometro dimenſa, erat 32′ 0″. Erantque in linea verticali cum centro Lunæ Pythagoras & Helicon.

H.	′	″		
2	38	30		Initium eclipſis contra Heveli-um.
	41	0		Grimaldum.
	42	30		Qui totus immerſit.
	43	0		Galilæum.
	47	0		Ariſtarchum.
	48	30	Umb. ad	Kepplerum.
	50	0		Gaſſendum.
	58	0		Copernicum.
3	3	30		Sinum æſtuum orientaliorem.
	9	0		Tychonem.
	17	30		Menelaum.
	24	30		Poſſidonius totus in Umbra.
	26	0		Fracaſtorem.
	31	0	Umb. ad	Proclum.
	32	0		Mare Criſium.

Umb.

H.	′	″		
3	35	30	Umb. ad	Langrenum.
	39	0		Immerſio totalis inter Langrenum, & mare Criſium.
5	17	10		Emerſio prima lucis infra Grimaldum.
	21	0		Grimaldus prodire incipit.
	22	25		Totus emerſit.
	28	0		Emerſit Gaſſendus.
	30	35		Kepplerus.
	36	40		Umbra per centrum Tychonis.
	37	20		Totus prodiit.
	40	35		Prodiit Copernicus.
	46	28		Plato incipit emergere.
	48	30		Totus detegitur.
	50	0		Sinus æſtuum.
	53	50		Architas.
	55	20		Manilius.
	57	15	Emerſêre	Ariſtoteles.
	58	45		Menelaus.
	59	10		Ariadæus.
6	0	50		Fracaſtor.
	2	30		Reſtat in umbra ¼ diametri Lunæ.
	2	50		Plinius.
	5	45		Poſſidon. Vitruv. & Cenſorinus.
	10	0	Prodeunt	Taruntius.
	10	30		Proclus.
	13	10		Langrenus totus detectus.
	13	30		Mare Criſium incipit emergere.
	16	30		Totum prodiit.
6	17	40		Finis eclipſis contra mare Criſium, exiſtente tum in linea verticali per centrum Lunæ Oenopide ac Heraclide.

VII. Nova Literaria Phyſico-Medica curioſa; *containing a Deſcription of the* Cereus *which flowered at* Norimberg *in the Year* 1730. *Communicated by* Jo. Georg. Steigertahl *Arch. Reg. Hanov. Prof. Helm. Soc. Honorar. Coll. Med.* Lond. *&* R. S. S. *to Sir* Hans Sloane *Bart. Pr. R. S. & Coll. Med.* Lond. *Tranſlated from the* Latin *by* T. Stack, *M. D.*

THE *Cereus Peruvianus* happened lately to flower at *Norimberg*, in the Garden of Mr. *John Magnus Volkammer*, who is well known to the World by his *Heſperides Norimbergenſes*. Upon this Occaſion Dr. *Chriſtopher James Trew* made uſe of all poſſible Care and Induſtry to acquire a thorough Knowledge of this Plant. Wherefore we will compendiouſly communicate his Obſervations at preſent, waiting his own giving an ample Account thereof, with Copper Plates, ſuch as he has ſome Years ſince given of the *American* Aloe with the utmoſt Accuracy and Diligence.

This *Cereus*, ſeparated from another, of which it was a Branch ſeven Years ago, and expoſed in open Air all Summer, grew without puſhing forth Branches. It is ſix Foot three Inches high, and thirteen Inches thick. It has ſeven Angles at its Baſis, eight about the Middle, and nine near the Top. Its upper Part is of a Sea-Green, on Account of the Powder with which it is covered; its lower of a Graſs-green. The Down of its Prickles is between Pale and White about the Top, every where elſe it is Brown. On the fifth of *September*,

September, at the Height of ſix Foot two Inches from the Ground, it ſhot a certain round Knot from its Trunk, which without any help of Art, ſo encreaſed and extended almoſt horizontally, that on the fourteenth of the ſame Month, it was eight Inches long, and plainly ſhewed a Flower, though as yet cloſed, embeliſhed with a beautiful Mixture of Green, Purple, and White. This ſame Evening the Flower began to open, and continued till Midnight; when being entirely ſpread, it was ſix Inches in Diameter. It was of a pretty ſtrong, but not very pleaſant Smell. After Midnight it gradually contracted about half an Inch, and remained thus till next Day at Noon. Then it began to contract faſter, to half the Diameter the expanded Flower was of; and the next Morning it was quite cloſed and withered, but hung on the Trunk till the thirtieth of *September*. The Beginning of the Flower is a ſort of Tube three Inches long, not quite an Inch thick, between a yellow and a pale Green. Its Surface was ſmooth, but chanelled by certain ſmall narrow Furrows, between which, blunt Protuberances were ſeen to run, in a parallel Order, along the Ridges. Where the Tube expanded itſelf, it divided into more than forty petaloid Segments, ranked in ſix ſeparate Series, the three inferior and exterior whereof here and there confounded their Order, while the three ſuperior and interior remained regular and unmixed. Theſe Series were diſtinguiſhed by their Size and Colour. The firſt, or exterior was of the ſame Colour with the Tube, *viz.* of a pale Green; but its upper Part gradually inclined to a Purple. The ſecond and third had half the inner Part greeniſh, the Edges of a more intenſe Purple. The fourth was between yel-

low

low and white, terminating in purple Tops. The Tops of the fifth were likewiſe purpliſh. The petaloid Segments of the ſixth were very tender and white. The Segments are of an oblong Figure, and in the firſt Series were terminated with blunt, in the others, with more and more pointed Tops. The inner or ſixth Series, which contained thirteen of theſe Segments, exhibited all the Edges finely and lightly, but irregularly cut and divided. The *Piſtillum* of equal Height with the Surface of the Flower, and hollow like a ſmall Tube, ran, at its upper End, into as many fine pale Filaments, ſpread in the Form of a Crown, as there were Segments in the inmoſt Row, *viz.* thirteen. The Day before the Flower dropped from the *Ovarium*, the Place where it was to ſeparate was marked by a blackiſh Circle, at which the Tube ſeparated ſpontaneouſly from the *Ovarium* or *Matrix*, that is, the Rudiments of the Fruit; the *Piſtillum* ſtill firmly adhering to the *Ovarium*. The Flower, now fallen, being diſſected longitudinally, the Origin of the *Stamina* lay open to the Eye; and it very manifeſtly appeared that the petaloid Segments of the Flower, far from affording the leaſt Mark of a natural Partition, ſtuck ſo very cloſe to the Tube, that not one of them would quit it without tearing it off by Violence.

The Fruit, though it came not to its full Growth, plainly evinced, by Inſpection alone, that it is not prickly. Upon Diſſection it afforded a viſcous Juice, and within was a certain Cavity, the Sides whereof were every where, except at the Bottom, thick ſet with an innumerable Quantity of ſmall *Villi*,

to

to each one of which hung an oblong, white, pellucid Veſicle, which is the Rudiment of the future Seed.

We hope this Deſcription will not be unacceptable to Lovers of Botany, not only becauſe the *Cereus* does not often flower, nor are there always at hand Perſons either able, or willing to give the Attendance requiſite for rightly obſerving and deſcribing ſo tranſient a Flower: But alſo becauſe it plainly diſcovers the Errors committed, even by very great Men, in the Deſcription of this Plant and its Flower. The Groſſeſt of theſe Errors, doubtleſs, is their ranking it unanimouſly among the polypetalous Flowers, whereas it is monopetalous. But as for other Remarks, which our moſt diligent Author has furniſhed us with, for correcting the Hiſtory of this Plant, we will, for want of Room, refer to the next Opportunity.

Dec. 20.
1730.

F I N I S.

ERRATA in the Thirty-sixth Volume of *Philoſophical Tranſactions.*

N°. 407. p. 7. l. 22. read *ſucceſſively.*
409. p. 107. for *oen* read *een*, f. *nyt* r. *uyt.*
410. p. 139. l. 17. f. *credör* r. *credo.*
410. p. 146. l. 12. f. *venticulus* r. *ventriculus.*
ib. l. 22. f. *tns.* r. *tus.*
ib. l. 22. f. *continentur* r. *continenter.*
p. 150. l. 18. f. *proxinantes* r. *propinantes.*
p. 153. l. 1. f. *Cautis* r. *Caulis.*
411. p. 211. l. 5. f. *Wiſp* r. *Whiſp.*
413. p. 259. l. 18. f. *Orificis* r. *Orificio.*
414. p. 345. l. 4. from the Bottom, f. *Acites* r. *Aſcites.*
p. 346. l. 6. from the Bottom, *the ſame.*
p. 356. l. 3. f. *unlike* r. *unlikely.*
415. p. 434. *vide Errata.*
p. 378. l. 5. f. *villoſo*, you may read *hirſuto*, the Word *villoſo* being uſed in the Original Deſcription, and *hirſuto* in the Title of the original Picture of the Plant.
416. p. 441. l. 5. from the Bottom, r. *Apple, and Pear-trees, of Poplar*, &c.
p. 452. l. 6. dele the , between *near* and *the Part*, &c.

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